KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, NOV. 7, 1884.

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THE CHEMISTRY OF COOKERY.

By W. MATTIEU WILLIAMS.

XLVI.—THE COOKERY OF WINE-DRYING.

THE reader will understand, from what has already been stated concerning the origin of the difference between natural sweet wines and natural dry wines, that the conversion of either one into the other is not a difficult problem. Wine is a fashionable beverage in this country, and fashions fluctuate. These fluctuations are not accompanied with a corresponding variation in the chemical composition of any particular class of grapes, but somehow the wine produced therefrom obeys the laws of supply and demand. For some years past the demand for dry sherry has dominated in this country, though, as I am informed, the weathercock of fashion is now on the turn.

One mode of satisfying this demand for dry wine is, of course, to select a grape which has less sugar and more albuminous matter, but in a given district this is not always possible. Another is to gather the grapes before they are fully ripened, but this involves a sacrifice in the yield of alcohol, and probably of flavour. Another method, obvious enough to the chemist, is to add as much albuminous or nitrogenous material as shall continue to feed the yeast fungus until all, or nearly all, the sugar in the grape shall be converted into alcohol, thus supplying strength and dryness (or salinity) simultaneously. Should these be excessive, the remedy is simple and cheap wherever water abounds. It should be noted that the quantity of sugar naturally contained in the ripe grape varies from 10 to 30 per cent.—a very large range. The quantity of alcohol varies proportionally when the must is fermented to dryness. According to Pavy, "there are dry sherries to be met with that are free from sugar," while in other wines the quantity of remaining sugar amounts to as much as 20 per cent.

White of egg and gelatine are the most easily available and innocent forms of nitrogenous material that may be used for sustaining or renewing the fermentation of wines that are to be artificially dried. My inquiries in the trade lead me to conclude that this is not understood as well as it should be. Both white of egg and gelatine (in the form of isinglass or otherwise) are freely used for fining, and it is well enough known that wines that have been freely subjected to such fining keep better and become drier with age, but I have never yet met a wine-merchant who understood why, nor any sound explanation of the fact in the trade literature.* When thus added to the wine already fermented, the effect is doubtless due to the promotion of a slow, secondary fermentation. The bulk of the gelatine or albumen is carried down with the sediment, but some remains in solution. There may be some doubt as to the albumen thus remaining, but none concerning the gelatine, which is freely soluble both in water and alcohol. The truly scientific mode of applying this principle would be to add the nitrogenous material to the must.

I dwell thus upon this because, if fashion insists so imperatively upon dryness as to compel artificial drying, this method is the least objectionable, being a close imitation of natural drying, almost identical; while there are other methods of inducing fictitious dryness that are mischievous adulterations.

Generally described, these consist in producing an imitation of the natural salinity of the dry wine by the addition of factitious salts and fortifying with alcohol. The sugar remains, but is disguised thereby. It was a wine thus treated that first brought the subject of the sulphates, already referred to, under my notice. This, although sold to my friend at a good price, was a concoction of the character known in the trade as Hambro' sherry. It contained a considerable quantity of sugar, but was not perceptibly sweet. It was very strong and decidedly acid; contained free sulphuric acid and alum, which, as all who have tasted it know, gives a peculiar sense of dryness to the palate.

The sulphuring, plastering, and use of Spanish earth, described in my last, increase the dryness of a given wine by adding mineral acid and mineral salts. In a paper recently read before the French Academy by L. Magnier de la Source ("Comptes-Rendus," vol. 98, page 110), the author states that "plastering modifies the chemical characters of the colouring matter of the wine, and not only does the calcium sulphate decompose the potassium hydrogen tartrate, with formation of calcium tartrate, potassium sulphate, and free tartaric acid, but it also decomposes the neutral organic compounds of potassium which exist in the juice of the grape." I quote from abstract in *Journal of the Chemical Society* of May, 1884.

In the French *Journal of Pharmaceutical Chemistry*, vol. 6, pp. 118-123 (1882), is another paper, by P. Carles, in which the chemical and hygienic results of plastering are discussed. His general conclusion is that the use of gypsum in clearing wines "renders them hurtful as beverages;" that the gypsum acts "on the potassium bitartrate in the juice of the grape, forming calcium tartrate, tartaric acid, and potassium sulphate, a large proportion of the last two bodies remaining in the wine." Unplastered wines contain about two grammes of free acid per litre; after plastering, they contain "double or treble that amount, and even more."

A German chemist, Griessmayer, and, more recently, another, Kaiser, have also studied this subject, and arrive at similar conclusions. Kaiser analysed wines which were plastered by adding gypsum to the must, that is to the juice before fermentation, and also samples in which the gypsum was added to the "finished wine," *i.e.*, for fining, so called. He found that "in the finished wine, by the

* The wine trade has two rival magazines, both very high priced, exclusively devoted to its interests, besides others that are partially so.

addition of gypsum, the tartaric acid is replaced by sulphuric acid, and there is a perceptible increase in the calcium; the other constituents remain unaltered." His conclusion is that the plastering of wine should be called adulteration, and treated accordingly, on the ground that the article in question is thereby deprived of its characteristic constituents, and others, not normally present, are introduced. This refers more especially to the plastering or gypsum fining of finished wines (Biedermann's *Centralblatt*, 1881, pp. 632 and 633.)

In the paper above named, by P. Carles, we are told that "Owing to the injurious nature of the impurities of plastered wines, endeavours have been made to free them from these by a method called 'deplastering,' but the remedy proves worse than the defect." The samples analysed by Carles contained barium salts, barium chloride having been used to remove the sulphuric acid. In some cases excess of the barium salt was found in the wine, and in others barium sulphate was held in suspension.

Closely following the abstract of this paper, in the *Journal of the Chemical Society*, is another from the French *Journal of Pharmaceutical Chemistry*, vol. 5, p. 581-3, to which I now refer, by the way, for the instruction of claret-drinkers, who may not be aware of the fact that the phylloxera destroyed all the claret grapes in certain districts of France, without stopping the manufacture or diminishing the export of claret itself. In this paper, by J. Lefort, we are told, as a matter of course, that "Owing to the ravages of the phylloxera among the vines, substitutes for grape-juice are being introduced for the manufacture of wines; of these, the author specially condemns the use of beet-root sugar, since, during its fermentation, besides ethyl, alcohol, and aldehyde, it yields propyl, butyl, and amyl alcohols, which have been shown by Dujardin and Audigé to act as poisons in very small quantities." In connection with this subject I may add that the French Government carefully protects its own citizens by rigid inspection and analysis of the wines offered for sale to French wine-drinkers; but does not feel bound to expend its funds and energies in hampering commerce by severe examination of the wines that are exported to "John Bull et son Île," especially as John Bull is known to have a robust constitution. Thus, vast quantities of brilliantly-coloured liquid, flavoured with orris-root, which would not be allowed to pass the barriers of Paris, but must go somewhere, is drunk in England at a cost of four times as much as the Frenchman pays for genuine grape-wine. The coloured concoction being brighter, and skilfully cooked, and duly labelled to imitate the products of real or imaginary celebrated vineyards, is preferred by the English *gourmet* to anything that can be made from simple grape-juice.

I should add that a character somewhat similar to that of natural dryness is obtained by mixing with the grape-juice wine a secondary product, obtained by adding water to the *marc—i.e.*, the residue of skins, &c., that remains after pressing out the must or juice; a minimum of sugar is dissolved in the water, and this liquor is fermented. The skins and seeds contain much tannic acid or astringent matter, and this roughness imposes upon many wine-drinkers, provided the price charged for the wine thus cheapened be sufficiently high. After this, according to Gardner (Churchill's Technological Handbook, "The Brewer, Distiller, and Wine Manufacturer"), "the same marc is treated in a similar manner with a fresh quantity of sugar solution, and sometimes undergoes as many as three or four separate macerations, each successive infusion occupying a rather longer time. It will be easily understood that wine thus prepared costs less than very small beer, though its retail selling price may be regulated by the "*étiquette*" or label (from which I suppose our word ticket is derived) that is finally pasted on the bottles.

The special bouquets and curious flavours demanded by connoisseurs can be more easily added to mixtures largely composed of these second and third runnings than to simple grape-juice having its own grape flavour, just as the juniper flavour is more easily added to "silent spirit" than to whisky or cognac. We may thus obtain a clue to the mysterious fact that the market is well supplied with wines bearing the names of celebrated vineyards, of which the whole produce is bought by special contract by certain continental potentates. Many of these château vineyards are so small that they cannot actually produce one-tenth of the wine that is *commercially* derived from them.

FERTILISATION OF BROAD-BEANS.

By Grant Allen.

THE bean inquired about by "E. W. P.," he now writes, is the ordinary garden broad-bean, *Vicia faba*. He is sure that whatever insect pierces the corolla, bees do not. But *bees* is almost as indefinite an expression as *beans*. There are many beans and many bees, belonging to many genera and species. The common garden bumble-bee (*Bombus hortorum*) is the most frequent visitor of the broad-bean in England; though several other Bombi also enter it in the proper manner, and suck the honey which is secreted at the base of the tube formed by the petal-claws. These are the legitimate callers, and they fertilise the flower in the ordinary fashion, by rubbing off pollen from one blossom, and depositing it on the stigma of the next one visited. The great hairy bumble-bee, however (*Bombus terrestris*), not taking the trouble to enter the flower by the front door, as he ought to do, bites a hole through the tube formed by the calyx and corolla, and extracts the honey through it—of course, without correspondingly benefiting the flower. Müller has caught him positively in the act, both in the case of *Vicia faba* and of *Vicia sepium;* and I have personally verified either observation. *Bombus terrestris*, indeed, is a very powerful and lazy bee, much given to thus cutting the Gordian knot by biting holes and stealing honey, instead of getting at it by the mouth of the corolla, in the regular fashion. Müller records a case in which he watched "a female bumble-bee (*B. terrestris*) examining a columbine; she made several vain attempts to suck the honey, but after awhile, having apparently satisfied herself that she was unable to do so, bit a hole through the corolla. Having thus secured the honey, she visited several other flowers, biting holes through them, without making any attempt to suck them first; conscious apparently that she was unable to do so. He also observed a similar instance in relation to *Primula elatior*" (Lubbock). In my own garden, this same *Bombus* frequently bites holes through the long spurs of the common "nasturtium," or Indian cress (*Tropœolum majus*), and less often through the analogous curved organ in the Canary creeper (*T. Canariense*). As to the true hive-bees (*Apis mellifica*), they are comparatively rare visitors of the broad-bean, and they almost always effect their entrance through the holes previously bitten by the hairy bumble-bee. If "E. W. P." will get any local entomologist to point him out *Bombus terrestris* (one of the most marked and most easily recognised of our wild bees), and will then watch carefully whenever he sees one hovering about his broad-beans, he will probably succeed in tracing to their real source the bitten holes which he notices in the blossoms.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

I.—INTRODUCTION.

IN the vicinity of the delightful gardens at Kew, as doubtless elsewhere in suburban London, many beautiful villas of moderate proportions are now being erected. We were attracted to one of these tenements by a board, set forth in prominence at its outer gate, upon which, in black and white, the architect announced his commercial shrewdness by stating that the house in question was constructed upon the principle of the "Sanitary House" at the late Health Exhibition.

The placard invited inspection, and, impelled by a curiosity adequate to the boldness of the enterprising builder, we entered. Our surmise was that the vaunted building was extremely similar in outward appearance to its neighbours, which were flourishing long before the Health Exhibition sanitary abode was even in embryo. We confess that we were delighted to find the essential sanitary details, such as the drainage from the roof, the position of the soil, pipes, cisterns, &c., exactly what they "ought to was," as little Bouncer would have had it (Cuthbert Bede); but we were somewhat disappointed with those minor, yet nevertheless, essential things, which in their totality go to make up a comfortable, and, *ergo*, a healthy home. Freedom from draughts, one of the necessities of a modern dwelling, is to a very large extent dependent upon the suitable construction of the windows, doors, and fireplaces. As a solitary example, let us draw attention to those brethren of costermongers who vend sausage-shaped "ropes of sand," enveloped in crimson cloth by way of heralding "Father Christmas," to keep out the cold. They at once point to the inefficient structure of the accepted and prevalent type of window-frame; and, again, when the lower sash of the window is raised, the inevitable consequence is a violent gust of wind, caused through the narrow instead of a deep bead on the window-cill. Door draught-preventers, suitably devised hearth-stones and fireplaces, and adequate ventilating apparatus, are other items which call most urgently for attention, and here we invariably find one and all are almost shamefully neglected.

It shall be our duty, in our observations upon the framework of the modern dwelling to lay great stress upon all those measures, the greater number of which are the outcome of recent inquiries, and which tend alike to economy, cleanliness, and health. In doing so we shall have occasion to notice all the most valuable inventions, whether new or old, that are considered to be of importance from a sanitary point of view, and we invite the suggestions and co-operation of our friends to enable us, through their remarks, to make these articles of the highest possible practical value to our subscribers.

It is an incontrovertible fact that, next to a thoroughly sound and healthy abode, the questions of dress and foods affect the well-being of civilised communities most profoundly. Of the first of these, there is scope for almost illimitable research. We are at the outset made aware of the fact that our bodies, or rather the average human frame of modern Europeans, has through many generations been contorted to adapt itself, from time to time, to the extravagances of what is popularly called the "fashion of the times." The remarks of the talented director of the British Museum in *Nature* and elsewhere, under the heading of "Fashion in Deformity" (we here quote from memory), are familiar to all students of biology. That a tendency towards rational reform is not far distant may be gathered from the numerous dress associations that have lately come into existence. Not only should the form of the habiliment be considered, but the texture of the material employed to meet the requirements of each special case is almost as deserving of inquiry. And here we have ample scope for noticing some truly valuable innovations.

Foods act more directly upon the health of our bodily economy than either houses or dress. Without encroaching upon the ground of our valued contributor, Mr. Mattieu Williams, we hope to be able to adduce evidence as to how the various organs of the body are affected by diets in those minute interchanges which constitute the histological physiology of life; to give an outline of the morphology and physiology, or the correlated structure and functions of the substances which are commonly used as foods and stimulants upon the organs and tissues of the human frame, and to criticise the most deserving of those preparations which have recently been brought forward for the benefit of the public.

"On earth there is nothing great but man. In man there is nothing great but mind,"* such was the motto of the distinguished metaphysician of the school of Edinburgh, the late Sir Wm. Hamilton, Bart. The culture of the mind depends to a very considerable extent upon the manner of inculcation, especially with regard to the young. In household economics, therefore, it is imperative that parents and guardians ought to be cognisant of the many advances that have recently been made in this department, so that they may be enabled to extend to their children the most approved and tested methods for their highest benefit. The very furniture—the desks, seats, tables, and books; their shapes and sizes, are all matters of no inconsiderable importance; and we shall have a good opportunity of placing before the public some of the most reliable information which it has been our good fortune to compile upon this interesting subject. Thus will our endeavour have been fulfilled; we sincerely trust with some degree of benefit to the readers of our "Chapters on Modern Domestic Economy."

OTHER WORLDS THAN OURS.

A WEEK'S CONVERSATION ON THE PLURALITY OF WORLDS.

By Mons. de Fontenelle.

WITH NOTES BY RICHARD A. PROCTOR.

(*Continued from p.* 336.)

"THE rainbow likewise is not known to the inhabitants of the moon; for if the dawn is an effect of the grossness of the air and vapours, the rainbow is formed in the clouds, from whence the rain falls; so that the most beautiful things in the world are produced by those which have no beauty at all. Since then there are no vapours thick enough, nor no clouds of rain about the moon, farewel dawn, adieu rainbow. What must lovers do for similies in that country, when such an inexhaustible magazine of comparisons is taken from them?"

"I shall not much bemoan the loss of their similies or comparisons," says the Marchioness, "for I think them well enough recompensed for the loss of our dawn and rainbow; for by the same reason they have neither thunder nor lightning, both which are formed in the clouds. How glorious are their days, the sun continually shining! how pleasant their nights, not the least star is hid from them! They never hear of storms or tempests, which certainly are plain effects of the wrath of Heaven. Do you think then they stand in need of our pity?"

"You are describing the moon," I replied, "like an

* Ought this not to be: "On earth there is nothing so great as man: in man there is nothing so great as mind"?

enchanted island; but do you think it so pleasant to have a scorching sun always over our heads, and not the least cloud to moderate its heat? Tho' I fancy 'tis for this reason that Nature hath made great cavities in the moon: we can discern 'em easily with our telescopes, for they are not mountains, but so many wells or vaults in the middle of a plain; and how do we know but the inhabitants of the moon, being continually broil'd by the excessive heat of the sun, do retire into those great wells? Perhaps they live nowhere else, and 'tis there they build 'em cities; for we still see in the ruins of old Rome that that part of the city which was under ground was almost as large as that which was above ground. We need but take that part away, and the rest would remain like one of these lunar towns; the whole people reside in wells, and from one well to another there are subterraneous passages for the communication of the inhabitants. I perceive, madam, you laugh at me; yet, if I may be so free with a fair lady, you deserve it much better than I: for you believe the people in the moon must live upon the surface of their planet, because we do so upon ours; but quite the contrary; for, as we dwell upon the superficies of our planet, they should not dwell upon the superficies of theirs. If things differ so much in this world, what must they do in another?"

"'Tis no matter," said the Marchioness, "I can never suffer the inhabitants of the moon to live in perpetual darkness."

"You will be more concern'd for 'em," I reply'd, "when I tell you that one of the antient philosophers long since discover'd the moon to be the abode of the blessed souls departed out of this life, and that all their happiness consisted in hearing the harmony of the spheres, which is made by the motion of the celestial bodies. And the philosopher pretending to know exactly all they do there, he tells you that when the moon is obscured by the shadow of the earth, they no longer hear the heavenly musick, but howl like so many souls in purgatory; so that the moon, taking pity of 'em, makes all the haste she can to get into the light again."

"Methinks, then," says the lady, "we should now and then see some of the blessed souls arrive here from the moon, for certainly they are sent to us."

"I confess, indeed," said I, "it would be very pleasant to see different worlds. Such a voyage, tho' but in imagination, is very delightful. What would it be in reality? It would be much better, certainly, than to go to Japan, which at best is but crawling from one end of the globe to t'other; and after all to see nothing but men."

"Well, then," says she, "let us travel over the planets as fast as we can. What should hinder us? Let us place ourselves at all the different prospects, and from thence consider the universe. But, first, have we anything more to see in the moon?'

"Yes, madam," says I, "our description of that world is not quite exhausted. You must remember that the two movements which turn the moon on herself, and about us, being equal, the one always presents to our eyes that part of which the other must consequently deprive us, and so she always to us wears the same face. We have then but one moiety of her which looks on us; and as the moon must be supposed not to turn on her own center, in respect to us, that moiety which sees us always, and that which never sees us, remains fixed in the same point of the firmament. When it is night with her, and her nights are equal to fifteen of our days, she at first sees but a little corner of the earth enlightened, after that a larger spot, and so almost by hourly gradations spreads her light till it covers the face of the whole globe; whereas these same changes do not appear to us to affect the moon, but from one night to another, because we lose her a long time out of our sight."

"I would give anything that I could possibly fathom the awkward reasonings of the philosophers of their world upon our earth's appearing immoveable to them, when all the other celestial bodies rise and set over their heads within the compass of fifteen days. It is plain they attribute this immobility to her bigness, for she is forty times larger than the moon; and when the poets have a mind to extol indolent Princes, I doubt not but they take care to compare their inactivity to this majestic repose of the earth: however, this opinion is attended with one difficulty; they must very sensibly perceive in the moon, that our earth turns upon her own center. For instance, suppose that Europe, Asia, and America present themselves one after another to them in miniature, and in different shapes and figures, almost as we see them upon maps: now this sight must be a novelty to such travellers, as pass from that moiety of the moon which never sees us, to that which always does. Ah! how cautious would they be of believing the relation of the first travellers, who should speak of it after their return to that great country, to which we are so entirely unknown!"

"Now, I fancy," says the Marchioness, "they make a sort of voyage from one side of their country to the other, to try to make discoveries in our world, and that there are certain honours and privileges assigned to such as have once in their lives had a view of our great planet."

"At least," replied I, "those who have had this view obtained the privilege of being better lighted during their nights. The residence in the other moiety of the moon must of necessity be much less commodious in that respect. But now let us continue the journey we proposed to take from one planet to another, for I think we have had a pretty curious survey of the moon; at least you have seen all I can show you."

(To be continued.)

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

ABOVE THE SURFACE—*(continued)*.

THE caddis-flies, which we left a short time ago, just emerging from pupahood, may now engage our attention. Of these insects we have upwards of 150 species already recorded from the British Isles, but, no doubt, others exist which have not yet fallen into the hands of the very small band of entomologists specially interested in the group. The larger kinds, which in some cases reach an expanse of wing of almost two inches, are nocturnal in habits, concealing themselves by day amongst herbage and on the trunks of trees. But many of the smaller ones may be seen during the daytime flitting backwards and forwards with an uncertain kind of movement just above the surface, seeming sometimes to be trying how near they can approach the water, without actually touching it. All these insects are delicate in texture, their four membranous wings being easily damaged, and their soft bodies, like those of the May-flies, shrivelling up in an unsightly manner after death, a peculiarity which does not tend to lessen the difficulties that, at the best of times, beset the discrimination of the species. The wings, which are always some shade of brown or black, are sometimes, like those of moths, adorned with patterns, and as, in many respects, they closely resemble the latter insects, for which, indeed, they are often mistaken, it will be best first of all to point

out the differences between the two orders, *Lepidoptera* (moths) and *Trichoptera* (caddis-flies).

On placing examples of each side by side, with wings expanded, a superficial glance will detect little more difference than that the wings of the caddis-fly, especially the hind pair, have a semi-transparent and somewhat glossy and iridescent appearance which is absent from those of the moth, and the most important structural differences will need microscopic work for their complete determination. Applying the microscope first to the wings, we find that in the moth the pattern is due not to the colour of the wings themselves, but to innumerable minute appendages in the form of tiny scales attached to the wing by the pointed end only, lapping over one another like slates on the roof of a house. and producing by their different colours a sort of mosaic pattern, the elements of which are so small that the mosaic effect is lost when viewed simply by the naked eye. On removing the scales, which can be done by gently brushing with a camel's hair brush, we find that the true wing consists of a transparent, colourless membrane with nervures forming its framework. Examining the caddis-fly in the same way, we see that the nervures are more numerous, and that such pattern as there may be, which is generally not a great deal, is produced partly by the coloration of the membranous wing itself, and partly by minute *hairs*, not scales, scattered more or less thickly over the surface. These differences will generally suffice for the separation of moths from caddis-flies; but there are a few moths that, so far as appearance and clothing of wings are concerned, approach very near to the Trichopterous type, the wings being semi-transparent, glossy, and iridescent, and the scales attenuated to such a degree as to be scarcely distinguishable from hairs, a condition best exemplified in the common pale brownish moth, *Nudaria mundana*. The antennæ of a caddis-fly are generally proportionately longer and stouter than those of a moth and are carried, pointing straight forward in front of the head. In the organs of the mouth (Fig. 1) there is a

Fig. 1.—Side view of head of moth (A) and caddis-fly (B); *a*, base of antennæ; *lp*, labial palpi; *m*, maxillæ; *mp*, maxillary palpi.

great difference. The moth carries a pair of long, flexible appendages closely applied to one another, and curled up in a flat coil which is placed in a vertical plane underneath the head; no such coiled apparatus exists in any other kinds of insects. On each side of this coil is a jointed organ, clothed more or less thickly with scales, the pair of which form between them a sort of groove, into which the coil fits. These two pairs of organs are called respectively maxillæ and labial palpi, and are the principal organs of the mouth in the Lepidoptera. The maxillæ, which can be uncoiled at pleasure, carry along their inner edge, which is grooved, numerous short hooks, those of one side interlocking with those of the other, and thus forming a central tube, up which the liquid food taken by the insect must pass in order to enter the mouth, an aperture between the bases of the maxillæ. In the caddis-fly the only organs distinctly perceptible are two pairs of delicate, jointed appendages, the maxillary and labial palpi. Though its larva possessed a pair of stout jaws, and was able to make good use of them, the perfect insect is, equally with the moth, entirely destitute of any such organs; the moth's coiled maxillæ, however, sufficiently distinguish the insect. In a few moths the maxillæ are quite rudimentary, the palpi being almost the only recognisable mouth organs; this manifestly approximates the mouth in appearance to the Trichopterous type, and there is a noteworthy instance in which even competent entomologists were for a time misled by this condition. The insect in question is a small, whitish moth, called *Acentropus niveus*, which, as it is a genuine lover of ponds, will come in for more lengthened notice later on; it was bandied about from one order to the other, at one time being considered a caddis-fly, at another a moth, till, the discussion having waxed hot and strong, it found a final resting-place amongst the Lepidoptera.

Some of the caddis-flies, viz., those of the family *Leptoceridæ*, are remarkable for the enormous length of their antennæ, which are sometimes four or five times as long as the body. It is these little creatures, some of them sooty black in colour, that form dancing groups just above the surface of the water. By entomological beginners they are sure to be mistaken for moths, especially as there is a well-known family of moths of the same size, of similar shape, with equally disproportionate antennæ, and with their colours, too, sometimes not unlike those of the Leptoceridæ. Attention to the structural characteristics mentioned above will, however, infallibly lead the observer to their true systematic position. It should constantly be borne in mind that mere superficial resemblances count for nothing to the systematist; insects that *look* something alike in general appearance are not necessarily at all related, for there are numerous instances of mimicry between species belonging to altogether different orders; an examination, therefore, which pays more attention to general effect than to matters of detail, will often fail to detect either real points of similarity or of disagreement; and students of entomology should be very careful in forming an opinion as to an insect's systematic position without the closest scrutiny of all essential parts, assisted by at least a hand-lens, and, if necessary, even by the compound microscope.

Caddis-flies are to be found during the summer months. They fly with a heavy, zigzag sort of flight, and when in the net often simulate death, bringing the wings close alongside the body (the hind pair, which are much larger than the fore, being folded up like a fan), relaxing their hold, and falling over on their side. But any attempt to secure their persons will speedily convince them of the futility of this pretence, and elicit spasmodic struggles for liberty.

There are some other water-frequenting, winged creatures, such as the stone-flies, willow-fly, and alder-fly, that, like the caddises, are used as bait by anglers, and are therefore sometimes confounded with them. These, however, though in habits resembling the subjects of the present paper, are pretty easily seen, by examination of the wings, not to belong to quite the same group; their wings are more or less closely reticulated by means of a number of *transverse* nervures in addition to the longitudinal ones (those of caddis-flies being chiefly longitudinal), and are only *very* slightly hairy, generally, indeed, imperceptibly so, without considerable magnification; and, in consequence, are more transparent than those of caddis-flies. Most of them, too, carry two long filaments at the tail, which the true caddis-flies never do. These insects, together with a number of others, such as May-flies, dragon-flies, snake-flies, and lacewing-flies, constitute the wonderfully mixed assemblage known as the order Neuroptera—a group with which

some people associate the caddis-flies. The stone-flies and willow-fly, together with the angler's "Yellow Sally," constitute the family *Perlidæ*, a group of that section of the order called Pseudo-neuroptera. The alder-fly belongs to the *Sialidæ*, a family of another section called Planipennia, which contains also the beautiful lacewing-flies, or "golden-eyes." But a more detailed notice of these must be reserved for our next paper.

(To be continued.)

FRENCH BALLOON EXPERIMENTS.

By Richard A. Proctor.

I HEARD with suspicion rather than surprise of the apparent success of Captains Renard and Krebs in directing a balloon against the wind. It is so manifest that the balloon is unsuited for aërial navigation that I took it for granted there could have been very little wind, if any. Possibly, even, an upper current in a different direction from the lower one favoured the aeronauts during that first experiment. When there was a breeze worth mentioning, and its direction adverse, the experiment failed, as it was bound to do. When we consider the nature of the task which a balloon-director has to achieve, we readily see that the problem is a hopeless one. To support the weight of a man, a balloon must have more than a thousand times a man's volume. To support an engine, the balloon must have at least six thousand times the volume of the engine. To support several men and an engine equal in weight to several more, the balloon must have theoretically a volume of forty or fifty thousand cubic feet; but really a much greater volume, because of the weight of the balloon itself, the necessity of carrying ballast, and so forth. Again, the hydrogen is not pure, and it is not at atmospheric pressure, but at greater pressure, as the distension of the balloon shows. A spherical balloon would have to be nearly 60 feet in diameter to contain 100,000 cubic feet, or thereabouts, of gas. Such a balloon would present to the wind an effective resisting surface of about 2,700 square feet, and certainly no force of propulsion which any engine carried by such a balloon could produce for more than a few minutes, would suffice to resist the action of the wind on such a surface when there was anything of a breeze. By giving to the balloon a fish-like shape, as Captains Renard and Krebs did, the propulsion of the balloon directly in the teeth of the wind is of course made easier; but, as in the great majority of cases there would be no advantage in going directly against the wind (it is always as unlikely that that would be the best course, as a course directly with the wind), the fish-like shape is disadvantageous rather than otherwise, for it enormously increases the resisting surface when the wind is abeam. A great mistake, indeed, is made by those who compare the movements of a balloon in the air with the movements of a fish in the sea. They seem to suppose that the fish shape will be a help against the action of the wind; but this is as absurd as it would be to suppose that a fish placed in the midst of a current or river carrying it bodily along would be helped by its shape to resist the action of that current. The fish can swim athwart the current or river, but all the time it shares the motion of the stream in which it is placed. Until it is shown to be possible to urge a monstrous balloon through the air at a rate considerably exceeding that of a stiff breeze, nothing is to be hoped for from balloon-supported propellers. Of course, this is hopeless; but a propulsive action, much less effective, would suffice to keep afloat a flying machine supported (as a condor or an albatross is supported) by a widely-extended horizontal surface.—*Newcastle Weekly Chronicle.*

ELECTRO-PLATING.

By W. Slingo.

XIII.—SILVERING SOLUTIONS (*continued*).

THE process of dissolving silver in nitric acid may be dispensed with by purchasing the nitrate of silver prepared in the crystalline form. It is a rather dear way of going to work, but if a good price be paid at a good shop, purity may be relied upon, and this is more than can always be said for an amateur's work. Experience, however, would very speedily put matters right in this direction. Care should be taken that the nitric acid is of good quality, as impurities are certain to lead to waste, if not disaster. Hydrochloric acid, one of the more generally present impurities of nitric acid, precipitates a portion of the silver as the chloride, which portion is consequently wasted.

Having prepared the nitrate of silver solution, a solution of cyanide of potassium is added gradually; the latter solution being made by dissolving about a quarter of a pound of cyanide of potassium in a pint of water. The effect of the cyanide of potassium upon the nitrate of silver is to convert it into the cyanide of that metal, which, being insoluble in water, falls to the bottom of the vessel. The liquid then becomes nitrate of potassium instead of silver. Care must be taken not to add too much of the cyanide of potassium solution, in consequence of its having the power of dissolving the cyanide of silver. If too much should be accidentally added, it is best to neutralise it by the addition of an extra quantity of nitrate of silver solution. These operations are best conducted in a glass vessel, so as to enable the progress of the precipitation of cyanide of silver to be carefully watched. When the precipitation ceases, and the whole of the silver has been allowed to settle at the bottom of the vessel, the clear supernatant liquid is gently decanted, and the precipitate washed a few times. The washing process consists in simply pouring a quantity of water on to the cyanide of silver, and, after allowing a settlement, pouring it off again. It is advisable to "test," or try, the solution as the cyanide is added. Although the white cyanide of silver forms a somewhat dense precipitate, it nevertheless takes some time to settle, the worker is consequently liable to mistake the degree to which he has converted the silver solution.

One tolerably sure indication that the necessary amount of cyanide of potassium has been exceeded is that, where the superfluous cyanide passes, it clarifies the solution by redissolving the suspended particles of cyanide of silver. The safest plan, however, is to allow the sediment to settle, and then to remove a little of the clear supernatant liquid, and, placing it in a test-tube or other small glass vessel, add a drop or two of the cyanide of potassium solution; the slightest cloudiness supervening is a sure indication that some of the silver remains unprecipitated, and accordingly more of the cyanide of potassium solution should be added to the main bulk of the nitrate of silver solution, and after a short time a further test should be taken in the manner above indicated. Should it happen, however, that the addition of the cyanide to the test-tube fails to precipitate any silver, there may possibly be already present an excess of the cyanide. This will be proved if, on the addition of nitrate of silver, cloudiness ensues. Of course, more nitrate must be added than would be necessary to

neutralise the few drops of cyanide added for testing purposes.

A little stronger solution of cyanide of potassium is now poured gradually over the precipitated cyanide of silver until the whole of it is again dissolved, a glass stirrer being continually used to facilitate the solution. A small quantity of the cyanide of potassium—say about three-quarters of an ounce—is then added to expedite the subsequent solution of the silver anode. The solution is next diluted with about a gallon of water, and then filtered to remove any impurities that may be present. It is then ready for the bath.

As hinted in the previous article, the amateur may experience some difficulty in procuring the cyanide of potassium, but a double salt—viz., the ferrocyanide—he should experience no difficulty in getting. With this he may make his own cyanide. The following is the process generally adopted:—Take a quantity of ferrocyanide of potassium, pound it fine, and gently heat it in an iron pan, with constant stirring, until quite dry; treat a quantity of the best carbonate of potash in a similar manner. When they are perfectly dry, add about three parts of the carbonate to eight parts of the ferrocyanide, and thoroughly mix them; heat the mixture rapidly in an iron ladle or crucible, until it melts into a clear liquid, when gas will be evolved from its surface. It should be maintained at a moderate or dull-red heat about fifteen or twenty minutes, and until the end of a cold iron rod dipped into it shows a white sample. The fusion should not be continued until the evolution of gas ceases, or the product will be of a grey colour. It should be kept covered as much as possible. By allowing it to stand undisturbed a few minutes at the latter part of the operation, and occasionally tapping the sides of the ladle or crucible, the iron of the ferrocyanide will settle at the bottom as a fine black powder. The colourless cyanide of potassium may then be poured off into a cold iron pan, or upon a thick and cold iron plate. It should be broken up while still warm, and preserved in a well-stoppered jar. The black sediment, which contains much cyanide of potassium, should be scraped out of the vessel while it is still hot and carefully preserved, as water will at any time dissolve out the cyanide. If the process has been well conducted, the product will be of a clear, white colour, or at most but very slightly grey. A larger proportion of cyanide of potassium is obtained by this process than when ferrocyanide alone is employed, because in the former case one-third of the cyanogen (that which was combined with the iron) combines with the potassium of the carbonate of potassium; whilst, in the latter case it is lost. The cyanide produced by the fusion of the ferrocyanide of potassium alone is of a greyish-black colour, and is termed "black cyanide."

Except where special preparations are made to produce a deposit having a bright surface, a dead or unpolished surface is produced, and if a bright surface is required, mechanical means are resorted to in order to obtain it. For some work, however, a dead surface is preferable, and it decidedly has beauties of its own. For such purposes a good solution is made by converting an ounce of silver into the nitrate by the method described in the previous article, and dissolving the crystals in three pints of distilled water. The silver is then precipitated (as the chloride of silver) by the addition of a strong solution of common salt. Having well washed the precipitate, it is next dissolved by the addition of a strong solution of cyanide of potassium, care being taken not to add much more than will dissolve the chloride of silver. The liquid is then filtered through two or three papers, and sufficient distilled water added to make one gallon of solution.

This solution answers very well, as above-mentioned, for dead work; more especially is this the case when the solution contains a larger proportion of water than that above-mentioned, when the battery power is weak, and when the anode is small. The deposition of silver under such circumstances would be much slower, and the particles would adhere more firmly to the object being coated.

A bright surface is imparted to the silver as it is deposited in the following manner:—An ounce of bisulphide of carbon is put into a pint bottle containing a strong silver solution with more cyanide of potassium than is necessary to dissolve the silver. The bottle, after being well shaken, is stood aside for a few days, and is then ready for use. A few drops of the solution may be poured into the plating bath occasionally, until the surface of the deposited silver attains a sufficient degree of brightness; care being taken, however, to add the bisulphide solution very sparingly or the depositing solution may be spoiled. This process is most applicable where bright surfaces are required, but which, owing to their irregularity, or to the fragile nature of the object, cannot be burnished in the manner to be presently described.

CHATS ABOUT GEOMETRICAL MEASUREMENT.

By Richard A. Proctor.

(*Continued from page* 339.)

A. I suppose geometrical measurements relating to curves, surfaces, volumes, &c., begin with the lengths of arcs?

M. We may begin with them, though the simplest methods and the best illustrations relate to surfaces.

A. How is that?

M. You will see if you consider what has to be done in the two cases. Always in measuring curved figures we have to conceive them divided up into great numbers of small parts, these parts being *not* affected by curvature. Now an arc cannot really be divided into straight lines; for no parts of it are straight. But we can divide a plane surface bounded by curved lines into great numbers of rectangles, triangles, &c. So we can divide a volume having a curved surface, into prisms, pyramids, parallelopipeds, &c. A curved surface is as awkward in this respect as an arc, for no part of it is plane.

A. Can you give me illustrations of your meaning?

M. Readily. In fact we must start from general illustrations of these peculiarities.

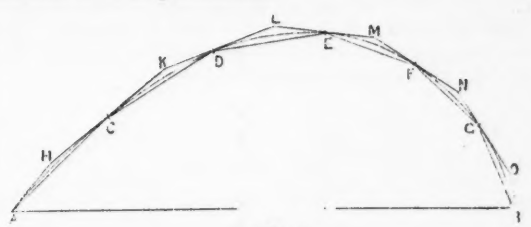


Fig. 3.

A. What then is the difficulty with arcs?

M. Suppose A E B (Fig. 3) is an arc we have to measure. We cannot divide this arc into straight portions no matter how small. If we set a number of points C, D, E, F, G, along the arc, we see that the straight lines A C, C D, D E, E F, F G, G B together, come nearer to the true length of the arc than A B. For while these straight lines together

are less than the curved lines A C, C D, D E, &c., together, —that is, less than the arc A E B—they are greater than A B, and so come nearer to the arc in length. So, if we divide the arc A C into a number of small ones, the chords of these together will be nearer in value than the chord A C to the arc A C. And so of the other arc C D, D E, E F, &c. Thus we get nearer and nearer to the length of A B, by taking a greater and greater number of chords along its length. Still this does not *prove* that we can approach the length of the arc within any quantity, however small, that may be indicated. For you may draw nearer and nearer to a quantity yet always remain separated from in by a finite quantity.

A. That sounds paradoxical.

M. Well, take the quantity 3. Suppose you take 1, add $\frac{1}{2}$ to that, $\frac{1}{4}$ to the sum, $\frac{1}{8}$ to that sum, and so on continually. Are you not continually approaching the value 3 (or indeed 4, or 5, or any number over 2)? Yet as your sum never exceeds 2, you are always separated from 3 by the finite quantity 1.

A. Still in the case illustrated by Fig. 3 it really looks as though you could get as near as you please to the length of the arc A E B, by increasing sufficiently the number of chords.

M. It looks so, and it is so; but you cannot easily prove it.

A. I observe in your figure a number of straight lines A H, H K, K L, L M, M N, N O, O B outside the arc A B. What do they mean?

M. They are tangents at A, C, D, E, F, G and B. It is tolerably obvious not only that A H, H K, K L, L M, M N, N O, and O B together are greater than the arc A B, but that by increasing the number of such tangent lines, we can approach the length of the arc A B as nearly as we please.

A. Yes; only you approach it from the other side, from outside, as it were. The real length of the arc lies between the sum of the chords and the sum of the tangents.

M. Precisely; and if we can show that these sums draw nearer and nearer to each other, and are finally separated by a length which may be made less than any that can be assigned we shall have obtained a satisfactory way of measuring arc lengths.

A. And I notice that so far as the set of outside lines are concerned we may be said to be following the natural way of measuring. For if we wished to measure the length of such a curved arc as A E B we should apply to it a fine string or a delicate chain, extended from A to B; and diminishing the number of our tangents A H, H B, &c., corresponds exactly to making the links of our measuring-chain shorter and shorter, which would naturally make the chain a more and more delicate measurer. But now *can* you prove that the outer and inner sets of short straight lines approach each other indefinitely?

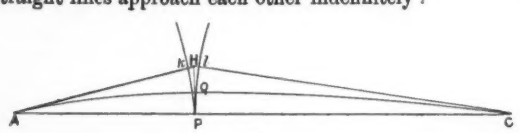


Fig. 4.

M. It will go near to be thought so presently. Let A C, Fig. 4, represent the A C of Fig. 3, A H the tangents at A and C (not necessarily equal). Draw H P square to A C, and with centres, A C, describe circular arcs, P k, P l, to the lines A H, H C. Then obviously the two lines H A, H C together exceed A C, by the sum of the two short lines H k, and H l. But since the arc A C, by the very nature of a curved arc, changes continuously through all the directions included within its length, the angles H A C, H C A, may be made as small as we please by bringing C near enough to A in Fig. 3. We can always magnify it to any size we please in Fig. 4. But P H is a tangent to the circles of which P k and P l are arcs; and it is obvious that the nearer we bring A H and C H to A C, the smaller k H and l H must become, and they can be made as small as we please, while A H and H C never become less than A P and P C. Therefore the excess of A H, H C together over A C may be made indefinitely small compared with A C. So that the sum of the excesses of A H, H K, K L, L M, &c., in Fig. 3, over A C, C D, D E, E F, &c., may be neglected compared with the sum either of A B, C D, D E, E F, &c., or of A H, H K, K L, L M, &c.

A. But may not these little "excesses," as you call them, though each is very small, made up an appreciable quantity through their number. As you increase the number of divisions you get more of these little bits.

M. That makes no difference. We make the ratio of each such pair as H k, H l in Fig. 4, to each part as A C, exceedingly small,—as small in fact as we please. The ratio of all of them together to all such lines as A C, C D, &c., together, cannot be greater than the ratio of the largest pair, like H k, H l to the chord corresponding to A C.

A. Illustrate this numerically.

M. Suppose you break up the number 1,000,000 into a million small parts pretty nearly equal, each therefore about equal in value to unity. Now, if from each of these quantities you take off a very minute fraction, say, one-millionth, you have a very large number—a million—of these millionths of unity (or thereabouts); but all together they cannot amount to more than one, a very small proportion of your original number. If you increase the number of parts of your original number to a billion, and take off a trillionth of each part, the sum of these billion trillionths will be just a trillionth of the original number. It matters not how great the number of these parts you take; if the ratio of each to that from which it is taken be very small, the sum of all of them will bear just that small ratio to the original total.

A. Is there any assumption at all, then, in your reasoning about arc lengths?

M. There is; though no one can really doubt its fairness. I have assumed that A H and H C together, are greater than the arc A Q C within these lines and touching them at A and C.

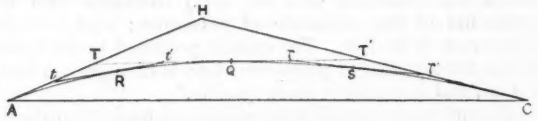


Fig. 5.

A. But obviously they are greater. Why, you can draw a tangent T Q T' to some point Q in the arc A Q C (Fig. 5). Then the broken line A T T' C is nearer to the arc A Q C than the broken line A H C, and is manifestly less than A H C (since T Q T' is less than T H, H T' together). Then we can draw the shorter tangents t R t', T S T'; and so on, getting continually nearer and nearer to the arc A R Q S C, and at each step diminishing the total length of the tangent chords.

M. Your reasoning is accurate. But still you require finally an assumption, when your drawing of tangents comes to an end. However I think we may fairly regard the assumption that *any* tangents as A H, H C are together less than the arc A Q C as to all intents and purposes axiomatic.

A. We have had a good deal of trouble over our preliminary inquiry into arcs. Can plane surfaces bounded by curved lines, and solids bounded by curved surfaces be more easily dealt with?

M. Much more easily. We will take them next; and consider also the more difficult case of curved surfaces. After that preliminary inquiry we will consider a number of cases of interest, in the measurement of various curves, surfaces bounded by curves, volumes, curved surfaces, and so forth, taking very simple cases first.

A. But will you not give me some examples of measuring arcs.

M. I must first explain how, instead of the chords and tangents shown in Fig. 3 we have usually to employ other approximations to the length of curved arcs.

(To be continued.)

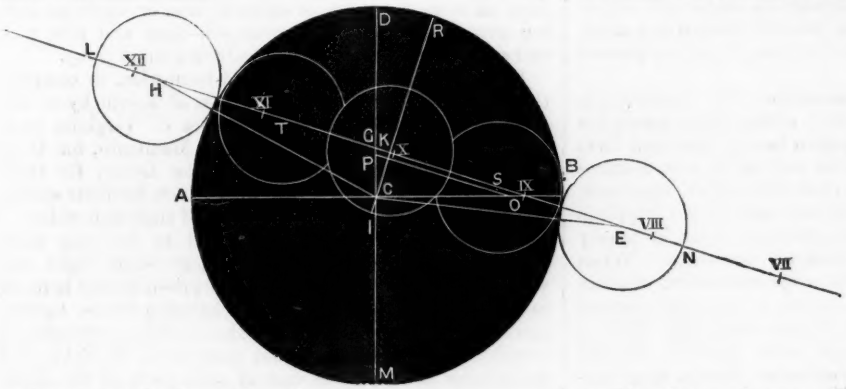
GRAPHICAL PROJECTION OF AN ECLIPSE OF THE MOON.

IN compliance with a request preferred by several subscribers, we propose to explain the method of graphically projecting a Lunar Eclipse from the details given in the *Nautical Almanac;* and, in order to render the principle perfectly intelligible, we have given all the successive steps (including the simple calculations) in the production of the subjoined diagram of the recent eclipse of Oct. 4, which has attracted so much attention.

First let us see what the *Nautical Almanac* furnishes us with. Turning to page 401, we find :—

ELEMENTS.

	h.	m.	s.
Greenwich Mean Time of Opposition in R.A., Oct. 4	10	8	5·1
Moon's Right Ascension	0	44	25·02
	°	′	″
Moon's Declination	N 4	57	57·9
Sun's Declination	S 4	46	33·6
Moon's Hourly Motion in R.A.		34	13·5
Sun's Hourly Motion in R.A.		2	16·7
Moon's Hourly Motion in Declination	N	10	52·9
Sun's Hourly Motion in Declination	S		57·7
Moon's Equatorial Horizontal Parallax		59	23·0
Sun's Equatorial Horizontal Parallax			8·9
Moon's True Semi-diameter		16	12·5
Sun's True Semi-diameter		16	2·4



Now then to begin our figure.

First, the figure of the earth is a spheroid, and not a sphere, so that her shadow is not rigidly circular. Hence, to have a mean radius, we will reduce the Moon's horizontal parallax to a latitude of 45°. This reduction we find to be, in the proper tables, 5″·9, so from 59′ 23″·0 we take 5″·9, leaving the reduced parallax 59′ 17″·1. The semi-diameter of the earth's shadow = Moon's horizontal parallax + Sun's horizontal parallax − Sun's semi-diameter—*i.e.*, in this case, 5° 9′ 17″·1 + 8″·9 − 16′ 2″·4 or 43′ 23″·6. To this we must add 1-60th, say, 43″·4, on account of the earth's atmosphere, and we shall finally get 44′ 7″ for the semi-diameter of the shadow. Take, now, any scale of equal parts (one of 40 to the inch, or 1½ inch to 1°, was employed in constructing our diagram above), and with 44·1 of them as radius, from centre C describe the circle A D B R. This will represent a section of the shadow of the earth at the Moon's distance. Draw the diameter A C B to represent a parallel to the equator, and make C G perpendicular to it=11′ 24″·3, the difference between the Moon's declination and that of the centre of the shadow. We must be careful to take G *above* C, because the Moon's centre is north of that of the shadow. The beginner will note that, as the Sun's declination is south, that of the earth's shadow must be north. Taking the hourly motion of the Sun in R A from that of the Moon (2′ 16″·7 from 34′ 13″·5) we get 31′ 56″·8 or 1916″·8 as the hourly motion of the Moon in R A from the sun, which we may now consider a fixture; but it must first be reduced to the arc of a great circle by multiplying by the cosine of the Moon's declination. This is done in three lines by logarithms. Thus :—

1916″·8	log. 3·2825768
4° 57′ 57″·9	cos. 9·9983668
1909″·6 or 31′ 49″·6	3·2809436

So we make C O=31′ 49″·6, and C P, perpendicular to it, = 9′ 55″·2, the Moon's hourly motion from the centre of the shadow in declination, observing to place P above C, because the Moon was going northward with reference to the shadow. Join O P, and parallel to it, through G, draw the line N G L. This gives us the Moon's path with respect to the shadow. On N L let the perpendicular C K fall. Now, at 10h. 8m. 5·1s. the Moon's centre was at G. To find where it was at 10h. (marked X on N G L) we say as 60m.: 8m. 5·1s. :: O P to G X. We take the corresponding measure off our scale, and, extending it from G, so find X. Then, in a perfectly obvious way we set off the distance O P on either side of our 10 o'clock point, and sub-divide these hours so graduated as minutely as we choose. Those in our figure might be so divided into 60 mins. each, without difficulty. Then will the times corresponding to E K and H represent the beginning, middle, and end of the eclipse respectively. Circles described round E K and H, with a radius= the Moon's semi-diameter (16′ 12″·5), will show the position of the Moon at these instants. R T shows what is known as the magnitude of the eclipse. If, with C as a centre, and a radius = C B—the Moon's semi-diameter, we describe a circle cutting L N in S T, the instants of the Moon's reaching these points are those of the beginning and end of total darkness.

ERRATUM.—In the reply to "W. H. K. S.," column 2, p. 373, in our last number "wilful imbecility" should be "wilful unbelief."

THE FISH RIVER CAVES, NEAR SYDNEY, AUSTRALIA.

By J. E. Richter.

THESE caves are situated about 80 miles west of Sydney, Australia, and are some 3,000 ft. above sea-level, in an interesting mountainous locality. They were first discovered by a party of settlers in 1866, while in pursuit of bushrangers.

Apart from the cave sights, that attract so many visitors, the locality surrounding affords an interesting study to the geologist and student of nature. A wall or ridge of limestone, hard as flint, and several hundred feet in height, stretches across country for several miles, sometimes as a ridge, at other places as an arch or bridge spanning streams. One of these creeks, containing a stream measuring several square feet in section, disappears under the limestone, embouching again a mile or so further down. Its subterranean course has never yet been traced. Contiguous to its course, little doubt exists of many undiscovered caves, possibly surpassing in beauty those at present shown to delighted visitors. In ages past this ridge of limestone, now so high above the sea, and eighty miles from it, was the bottom of the warm ocean, the abode and regenerative ground of the myriad tribe of shell-fish. Unearthing a detached piece of limestone from the red soil, different forms of shell are discernible over the surface of it, a substance in the soil eating or corroding certain parts of the limestone more than others, leaving the shell forms raised above the surface of it. Viewing these forms, it is significant that none of the shells originally forming a part substance of this limestone were larger than one and a half inches in any section. The line of junction of the limestone with other rocks is visible at several places. On the western side an indurated Silurian schist formation closes in upon it. At the other, softer schists. Another creek, after having worn out a passage for itself through this wall of limestone, immediately joins the stream beforementioned; and it is near the junction of these streams the caves are situated, so far discovered, and as shown to the visitor by the caretaker —the caves having been wisely reserved by the Government of New South Wales from any private proprietary speculation or interference. Where these streams have bored a passage through several hundred yards of this wall of limestones, traces are left sufficiently numerous to show that said streams had originally worked through at a much higher level; in after ages grinding deeper to the present bed.

These caves are singularly attractive. The intricate galleries, halls, and passages in their subterranean scenes are so truly magnificent that a person having once seen them is desirous of viewing them again and again, new features being presented to his view at each visit and at every turn. The strange forms that have been assumed by the drippings from the limestone are almost infinite, and are in beauty unsurpassable in their own character elsewhere. When lighted up by the incandescent magnesium wire, or other strong light, these sublime chambers, so strangely formed by Nature's hands, present a gorgeous spectacle, filled as they are with drooping sprays, coral growths, delicate pendants, gigantic columns, handsome shawls, huge curtains, and shadowy arches of the most fantastic kind. There is a good coach-road from the railway at Tarana to the caves, thirty-six miles.

The cavernous limestone of the Fish River is bluish-brown in colour, compact and hard; fractures easily under the hammer, leaving an edge sharp as that of flint. It is capable of taking a high polish, almost equal to that of the New Zealand greenstone, so much used in jewellery ornamentation at the present time in Australasia. At different places about the caves, where the configuration of the surface has forced the many animals of the kangaroo species, large and small, to travel on any narrow trail, the limestone is worn so smooth and polished by the feet of these indigenous animals that the face of the visualist is reflected to him as in a mirror at favourable spots.

The length of the numerous caves in their various turns and curves, ascents and descents, would probably measure several miles, taking about three days to view, while the student may spend three days more to advantage inspecting the many strange overground features of the neighbourhood, including the unique surrounding woodland scenery, typically Australian.

The fissured condition of some of the limestone in this locality is due to volcanic upheaval disturbance. Many of the smaller fissures have been filled since the upheaval by silicates and spar, some coloured, denoting the presence of oxides of iron and probably other metals, from which also the hard carbonates deposited in such lovely and various forms on the walls, or dependent from the domes and arches of the caves below, have obtained their variegated and diversified colours. Some of these silicates present an example of that rare combination, stratification and crystallisation.

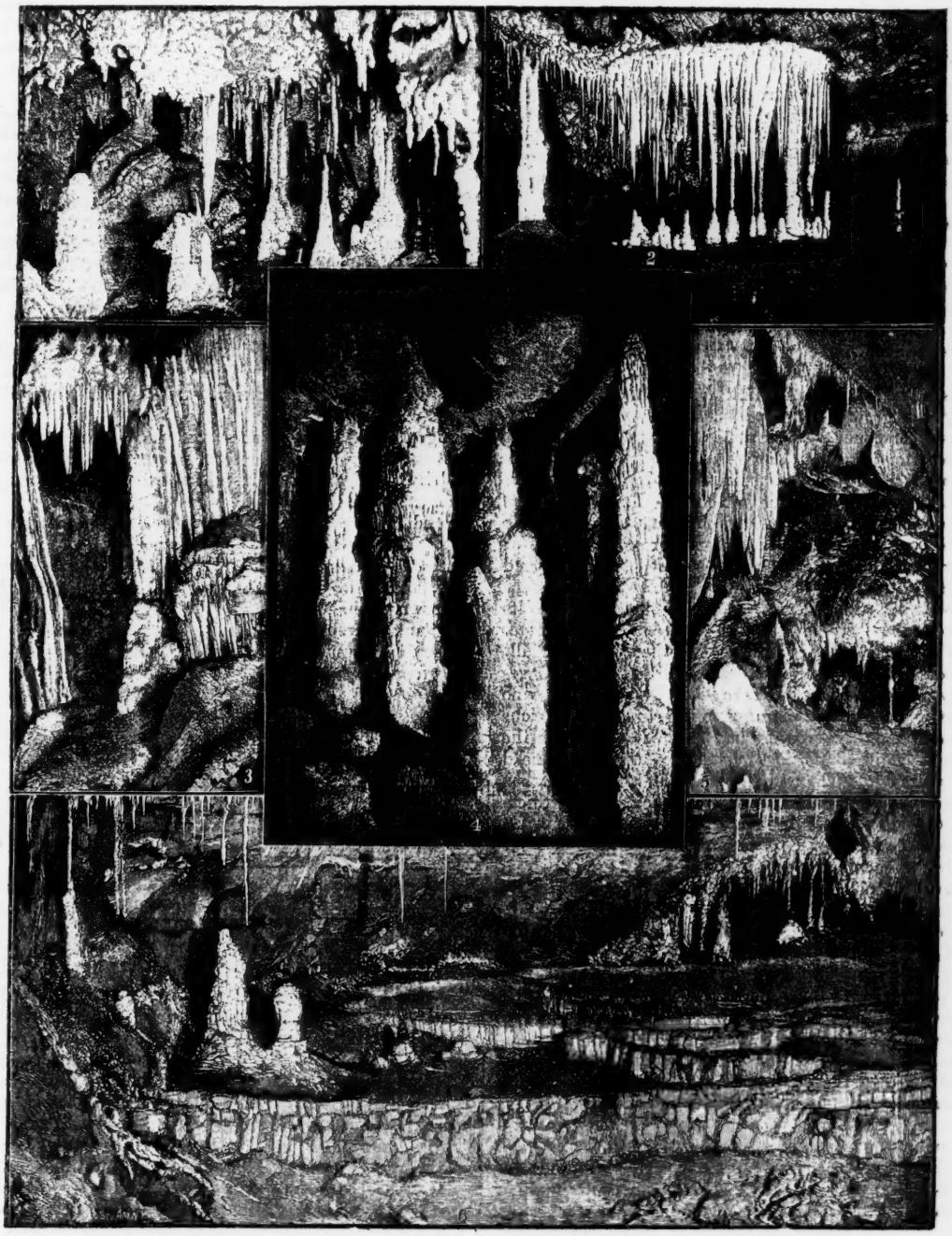
For two or three years after discovery the more accessible caves were partly despoiled by iconoclastic-inclined visitors breaking away the best stalacites and carrying them off to adorn their homes. Then the Government assumed charge of these marvels of nature, since which time the caves are locked at their various entrances by iron gates, and can now only be seen by the guidance of the caretaker, whose service is free of charge, the material for displaying light and cost of sustenance while there being the only charges made. Much improvement has been and is being made throughout to enable visitors, including ladies, to better see the many wondrous sights without the physical exertion that was necessary in former years.

Trenches have been dug in many places, so that one can now walk along upright where once it was necessary to crawl along on hands and knees, or wriggle along, caterpillar fashion, through passages that measured but 10 or 12 inches from floor to roof. Bridges have been thrown across chasms and pools, wire-ladders and stairs have been fixed at difficult ascents or descents, iron or wire-rope railing guards the more dangerous side-lines and pits, and rocks and other obstructions have been cleared away.

It would be difficult, as it would be unwise, to compare these caves with the Mammoth Caves of Kentucky or the more recently-discovered Luray Caves of Virginia, each having its own characteristics—the Mammoth, for their vastness and rosette-covered walls; the Luray, for their tessellar pendent features; the Fish River, for their spiked and filigree glasswork and shawl-draped roofs and walls.

The student of nature, accustomed to find the most exquisite symmetry, form, and colour where light and warmth are in most abundance, is surprised to find here, as in other caverns, that the most charming forms, figures, and colours have been slowly created in these underground corridors, in a temperature not more than 60° Fahr., and in darkness as intense as that of some parts of the Black Tartarus, as believed in by the ancients. This silent, enduring evidence rather upsets the assertions of those theorists who assert that the richest colours are not producible except by the aid of light or heat, or both conjointly.

In some of these caves we were often confronted by what at first sight has the appearance of the filigree work of the



1. Lolly Cave. 2. Nelly's Grotto, Imperial Cave. 3. Lucinda's Columns. 4. Columns, Nettle Cave.
5. The Shawl Cave. 6. Crystal Salt Pass.

glass-blower, as if a member of that craft had traversed it with a portable apparatus, and had in a haphazard fashion practised his art here and there in the most whimsical places, on walls, stalactites, in niches, on the arch under one's feet, and on the dome 50 ft. above.

In some places our attention was attracted to side floors, apparently thickly strewn with potatoes or turnips, covered by a half-inch of what appeared newly fallen snow. It is not snow, but a soft fungus or down closely resembling it; and, unlike a few minutes' fall of snow, is the gradual growth or decay of ages, no doubt the product of disintegrated carbonates, the potatoes being concretionary nodules, probably formed from the same substance. Near these and at other places the walls present the appearance of an irregular patchy Beton concrete work, or the white-washed dab plastering to be met with on the outside walls

of the houses of the German peasant—at other places, as if boys had been throwing small snowballs at the walls, which had stuck there, white as snow, a portion of it as soft too.

As illustrating the indestructibility of matter, the limestone, extremely hard though it be, wastes away in the presence of aqueously-saturated air, and under certain conditions on contact with water, and is deposited at lower levels in all those strange and curious forms that so exult visitors.

The caves that have their entrance from outside are but four or five in number: the Elder Cave, Nettle Cave, Lurline Cave, Lucas Cave. The Imperial Cave, the finest of all the number, was discovered but two years ago. All other caves are but sub-caves of these. The Lucas Cave is singular in its form, winding downward as it does until, at its further end, we find ourselves directly under the entrance portion, but 200 feet lower.

Let us pause a little, and think over the evidently extraordinary slow growth of that grotto of stalactites before us. From long continued observation, extending over a century, in the limestone caves of Europe and America, the results go to show that it takes a thousand years to make a foot in length of the slowest forming stalactites. It is equally certain, however, from the results of observations in the same caves, that the same length has been aggregated in 100 or 200 years, but the conditions under which each was formed being different. From one falls a drop of water but once in two or three minutes, much of the water previous to its falling as a drop being evaporated on its coming in contact with air or a current of air. From the other the water falls in an almost continual trickle. At the Fish River Caves the only observation as yet taken was by the guide, who informed us that, at the entrance to the cave, and previous to the path being lowered, he had accidentally broken the tip off a stalactite 8 in. long by striking it with his head sixteen years ago. The new growth, the growth of sixteen years, was but $\frac{3}{8}$ in. in length by $\frac{1}{4}$ in thickness, the thickness of the stem where broken off being about $\frac{3}{8}$ in. At the time of our visit, one to two minutes elapsed between the falling of each drop of water from it. At this rate it must have taken 360 years to form this stalactite of 8 in. length previous to its breakage.

At one place, measuring about 150 square feet, we counted 36 stalactites to the square foot, from an inch to 15 inches long, making about 5,000 delicate pendants in this sequestered nook. The longest stalactite noted in these caves was about 20 feet or less, and the tallest stalagmite about 10 feet, many of the latter assuming most peculiar shapes, as of human-like figures, hooded monks and nuns, of robed statues and statuettes, of fish standing on their heads or tails, of candlesticks, as in Fig. 2, to the right in Nelly's Grotto.

Throughout our subterranean travels, number of pools and basins from 4 inches to 20 feet in diameter, filled with water as clear as the distilled element, continually met our view, and in the strangest and most unexpected of places, too; on top of a mound, on shelves or ledges, on terraces, or in niches; while in vicinity of Fig. 6 is a sheet of water usually less than 6 inches in depth, 100 feet long, its bottom glistening with pearls and other concretionary forms like nodules, marbles, birds' eggs, &c., interspersed with patches of diminutive coral forms, a sight so dazzling to the eye that if continued becomes almost painful.

The Shawl Cave, Fig. 5, Nature has devoted to the display of shawls, and there are curtains from ten to twenty feet long, quarter to half-inch thick, and two to five feet wide. Some are nearly white, while others are more or less beautifully striated in white, pink, yellow, and brown, like the markings visible in agates and other precious stones. A light placed behind these curtains reveals some to be opaque, others translucent, and all extremely handsome. A tiny stream of water trickles down the edge of each shawl.

The Crystal Salt Pans, Fig. 6, are a number of shallow basins filled with beautiful semicircular sheets of gleaming water (basins dry when photographed), each basin being a terrace, and catching the overflow of water from the one above it. It was only after a second investigation that we could realise that the ruffled margins and corrugated brims to these calcareous pools were built up by deposition of material contained in the water itself, the deposit strangely taking place only at the point of overflow. These basins are sometimes dry, when they present the appearance of a number of evaporated salt-pans at a salt factory, the bottoms of the basins being then covered with shining crystals. Viewing the pillars to the left reminds the visitor of the ruined monumental columns met with in Italy, Palestine, or Greece.

Fig. 1, Lolly Cave, is an overcrowded curiosity shop, the most splendid gems hidden from view by inferior articles.

Nelly's Grotto, Fig. 2, is an assemblage needing no comment.

Solidified or petrified cascades and waterfalls are numerous throughout the caves. A few are spotless white in colour, others leaden blue, some striated in various shades of white, pink, and yellow, while more are of a transparent black or brown. The latter is also the prevailing colour about the diamond wells, where the carbonates are coated with a surface of crystals, the crystals being large.—*Scientific American.*

DICKENS'S STORY LEFT HALF TOLD.

A QUASI-SCIENTIFIC INQUIRY INTO

THE MYSTERY OF EDWIN DROOD.

By Thomas Foster.

(*Continued from p.* 358.)

AFTER the interview with the opium-eater, Datchery returns to his lodging, but merely to get his almost superfluous hat, that he may go out and seek the Deputy. He hails this promising youth by his seldom-used nickname Winks; and we find that the acquaintance between the two has been established on a familiar footing. ("Always kindly," Drood was, we were told in Chapter XIV.) "We two are good friends; eh, Deputy?" he says. "Jolly good." "I forgave you the debt you owed me when we first became acquainted, and many of my sixpences have come your way since; eh, Deputy?" "Ah! and what's more, yer ain't no friend o' Jarsper's. What did he go a histing me off my legs for?" "What, indeed?" says the quaint and Droodlike Datchery, whose talk here reminds one of Dickens's own talk with a little Irish boy, as described in a letter to Forster. Datchery gives Deputy a shilling to find out where the old opium woman lives. Hearing that she is going to the Cathedral in the morning, he "receives the communication with a well-satisfied, though a pondering face." As yet he has learned little from his meeting with the opium woman, except that she knows Jasper, that she is not very friendly towards him, and that opium is the secret of the strange resemblance he had noted six months before between her look and Jasper's. He opens the cupboard where he keeps the score of his reckoning against Jasper. A few uncouth streaks only are chalked on its inner side. He sighs over the contemplation of the poverty of the score, and is uncertain what addition

to make to the account. What he has learned *may* be of use to him, but he cannot yet see his way to profiting by it. "'I think a moderate stroke,' he concludes, 'is all I am justified in scoring up,' so suits the action to the word, closes the cupboard, and goes to bed."

It is very different with the events of the following morning. Observe the contrast between Datchery's feelings in the two cases. We have just seen that he sighed at the poverty of the score in the evening, yet with some doubt whether he *might* not be justified in attaching importance to what he had discovered. After the morning's experience, we are told in the very last words Dickens ever wrote that, before sitting down to his breakfast, Datchery "opened his corner cupboard, took his bit of chalk from its shelf, added one thick line to the score, extending from the top of the cupboard door to the bottom; and then fell to with an appetite." No sigh now at the poverty of the score, no moderate stroke added thereto, but a thick stroke from top to bottom of the cupboard door. Surely a statement inviting our most careful attention to the events which have led to Datchery's satisfaction.

Let us see, then, what happened that morning:—

Mr. Datchery attends the morning service at the Cathedral, and from a stall glances about him for "Her Royal Highness the Princess Puffer." The service is well advanced before he "has made her out in the shade." She is behind a pillar, carefully withdrawn from the Choir-master's view, but regards him with the closest attention." All unconscious of her presence, he chants and sings. *She grins when he is most musically fervid, and — yes, Mr. Datchery sees her do it!—shakes her fist at him behind the pillar's friendly shelter." Mr. Datchery looks again to convince himself.* YES, AGAIN. *She hugs herself in her lean arms, and then shakes both fists at the leader of the choir.* And at that moment, outside the grated door of the choir . . . Deputy peeps, sharp-eyed through the bars, and *stares astonished from the threatener to the threatened.*" Mr. Datchery has learned that the old woman knows Jasper for a hypocrite, and for some reason hates him (even more intensely than "good Mrs. Brown hated Mr. Carker"); and observe how carefully Dickens shows 1st, that Datchery learns this for the first time, and 2ndly, that it is news also and strange news to the Deputy. If Deputy had not stared astonished (as Datchery noted) at the old woman's demonstrations, he might have doubted, as Datchery might, whether Deputy had not told her how Jarsper had ill-treated him, and so excited her sympathies on his behalf; but we see that Datchery recognises in her an entirely independent knowledge alike of Jasper's evil nature and of some at least of his evil deeds. What the extent of her knowledge may be, he now inquires:—

"Well, mistress," he says, "you have seen him?"
"I've seen him, deary; I've see him!"
"And you know him?"
"*Know him!* BETTER FAR THAN ALL THE REVEREND PARSONS PUT TOGETHER KNOW HIM."

Here is the end. So much learned about the opium-eater's knowledge, Datchery's doubts and anxieties of overnight are replaced by satisfaction and good hope of success in his scheme for the punishment of Jasper.

It is clear that Datchery's plans depend on such information as he now sees that the old opium woman can obtain for him. Overnight he had no reason to suppose that she knew more of Jasper than that he was a slave to opium. Now he sees that in some way, doubtless through the effects of that drug, she has learned much about Jasper, and knows him to be the villain he is. From her, then, he may now hope to learn what he wants,—how far Jasper's attack was premeditated, what was the precise nature of his plot in all its details, and precisely in what way Jasper's punishment may be made most terrible.

It remains only that we consider what was the course thus indicated as that along which the main plot of the story was to have run. What was the particular punishment which Edwin Drood and Mr. Grewgious were preparing to inflict upon the hypocritical villain, who, pretending love for Edwin, had endeavoured not merely to kill him but to destroy all trace of him.

But first let it be noticed what a favourite idea with Dickens was the thought of a watch kept on a villain or a hypocrite by one whom he despised as powerless to injure him. Even in this specific form, the idea appears at least a round dozen of times in Dickens's novels, while the general idea of an unsuspected patient watch may be identified about twice as often. In "Barnaby Rudge" we have the murderer Rudge watched for years by the brother of the murdered man (on whom suspicion of the murder had been cast). In "Nicholas Nickleby" Ralph is watched to the last and all his plans foiled by the despised Brooker. In "Martin Chuzzlewit" the favourite idea appears in two important parts of the plot,—we see Jonas Chuzzlewit the murderer tracked to his doom by Nadgett whom he regards as little better than an idiot, and Pecksniff the hypocrite watched by old Martin whom he supposes to be decrepit and a dotard. Dombey is watched by the contemned Carker, Carker is tracked to the death by the despised Dombey. Blandois-Rigaud is hunted down by Cavaletto, Mademoiselle Hortense watched night and day by Mrs. Buckle, and Magwitch by his hated fellow-convict Compeyson. The "Tale of Two Cities" turns wholly on a patient watch maintained by despised folk on the descendants of those who had oppressed them. In "Our Mutual Friend" a man supposed to be dead watches the actions of more than one wrongdoer; in "Hunted Down" a murderous hypocrite is patiently watched to the death by one whom he supposes to be dying; in "A Trial for Murder," a murderer is watched by the spirit of the murdered man; and in "No Thoroughfare" the murderer (as he himself supposes) is confronted at the end by his supposed victim.

We need not wonder if it shall appear that the denouement of Edwin Drood was to turn on the watch kept on a murderer by a man supposed to be dead and not merely buried but destroyed in his tomb. The culminating horror of "a dead man rising from the tomb to confront him" on which Dickens dwells in the last scene of Jonas Chuzzlewit's villany, was to be actually wrought into the plot of "Edwin Drood."

(*To be continued.*)

H.M.S. *AGAMEMNON.*

THIS vessel, which is an armoured citadel turret ship of the *Inflexible* type, has recently been ordered to proceed to the Mediterranean. She has been hurriedly prepared for sea service after being nearly nine years in process of construction and undergoing alterations and modifications of various kinds. Her estimated cost has been enormously exceeded, and we recommend any member of Parliament, who wishes to learn something really worth knowing of how money is spent upon our ships of war, to move for a return of the estimated and actual costs of all the ships recently added to the Navy, with the cost also of alterations and additions made to the vessels now in progress. This information would show how much of the present wasteful expenditure is caused. The *Agamemnon* is one of those vessels which has enormously ex-

ceeded her original estimates, and has been nearly nine years building instead of the four—the time at first estimated. It may be supposed by some that an approximation to perfection is reached as a result of all this vast expenditure of time and money. This is not the case, however, with the *Agamemnon*. She is going upon active service with steering power so defective as to make her a terror to her officers, and dangerous, in some circumstances, to herself. Her movements are of a very erratic and uncontrollable character, and she cannot be kept properly in command by the helm. Steering is one of the most important qualities for a fighting ship to possess, and constitutes one of the prime elements of efficiency. The *Agamemnon* is being sent upon active service with this essential quality disgracefully and dangerously deficient. It is said that if the officers find that they can do nothing with her she is to put into Malta for alterations. How can Malta do what it has been impossible to do here in nine years? or, if not impossible, why was it neglected here? The cause of the defective steering is plainly to be seen in the form of the stern, which is so ingeniously contrived that the water is prevented in almost every possible manner from properly acting upon the screws and rudder. We commend a study of this stern to naval architects as an example of what should be avoided in designing the after-part of a ship. A model should be obtained for every naval museum.—*Engineering.*

Reviews.

SOME BOOKS ON OUR TABLE.

Annual Report of the Smithsonian Institution for the Year 1882. (Washington: Government Printing Office. 1884.)—Anyone who may feel even a lingering doubt as to the ample sufficiency of private enterprise and munificence for the encouragement and development of scientific research, may surely have that doubt dispelled at once by the perusal of the massive volume now lying before us: for its 829 closely printed pages contain records of investigations, explorations, and researches of the greatest possible importance; of the distribution of publications invaluable to the student of science; and of what may fairly be termed the effective general superintendence of the various branches of physical and natural science in the United States by an Eclectic Council, without any appeal to the national exchequer at all. Apart, however, from its instructive character in this respect, the latest Smithsonian Report may well be read for the vast mass of matter of the highest value contained in its appendix, which is made up of reports on recent progress in every department of science, besides papers specially relating to anthropology. Everybody who wishes to be *au courant* with the present condition of scientific knowledge should read this magnificent tribute to the wisdom and generosity of James Smithson.

The Church of England Sunday Service Book. Continuously arranged for 1885. Morning. (London: Henry Frowde, Oxford University Press. 1884.)—This is neither more nor less than a sequence of the complete services for the fifty-two Sundays of the forthcoming year exactly as they will be read in every church in the kingdom. All church-goers are familiar with the perfectly needless trouble inflicted on them by having to turn backwards and forwards through the ordinary Prayer-book, and will doubtless welcome this very much more simple and intelligible arrangement. The very low price at which the work under review is issued, places it within the reach of all.

Results of Rain and River Observations in New South Wales during 1883. By H. C. Russell, B.A., F.R.A.S (Sydney: Thos. Richards. 1884.) *New South Wales: Physical Geography and Climate. New Double Stars.* Same author.—In the two first works, whose titles head this notice, Mr. Russell deals exhaustively with the climate of New South Wales, and furnishes information of interest and importance to the settler. His "Catalogue of 130 New Double Stars" forms a valuable contribution towards our, at present not very perfect, knowledge of the Southern Heavens.

The Amateur Review. No. 1, October, 1884. (Crouch Hill: S. C. Collins. 1884.)—Abundantly justifies its title.

The Voice, Musically and Medically Considered. By Armand Semple, B.A., M.B. Cantab, &c. (London: Baillière, Tindall, & Cox. 1884.)—Every one who sings, or who proposes to acquire that delightful accomplishment should read Dr. Semple's instructive little pamphlet. Professing in this, his first, part to deal with musical considerations alone, our author yet interpolates something as to the anatomy and physiology of the human vocal organ. He classifies the various voices from bass up to soprano-sopracuto; discusses "timbre," the various registers, and the common defects of the voice; and points out in simple language the methods of rectifying them. He has given the musician a very useful little book indeed.

Reed Farm. By Mr. Robert O'Reilly. (London: Hodder & Stoughton. 1884.)—In these days of exaggerated and but too often prurient sensationalism, it is a positive relief to a healthy mind to take up a book so purely natural in its story and so innocent in its teaching as this. "Reed Farm" is a story about simple working people and their surroundings. As we turn its pages, the scent of the spring blossom, of the summer hay, and of the autumn fruit seems to fill the air around us; while we realise the individuality of each of the characters throughout the tale. "Chris" might be an elder brother of "Tiny Tim;" indeed, his interview with Aunt Betsy (unfortunately, too long for extract here) reminds us strongly of the master who created the poor little crippled child of old Scrooge's clerk. One conspicuous merit of this really charming book is, that while a reverent spirit pervades it from end to end, the "goody-goody" element is wholly eliminated from it. It would be hard to find a more attractive birthday present for young people verging on manhood and womanhood than this.

Heath's Fern Portfolio. By F. G. Heath. (London: Sampson Low, Marston, Searle, & Rivington. 1884.)—Nothing more beautiful in the shape of botanical illustration than these life-sized and life-like drawings of the fronds of our British ferns has ever been issued. To the fern-collector Mr. Heath's work is indispensable, if it be merely on account of the facilities which it affords for the identification of varieties not very commonly met with. In fact, so admirably are the figures drawn and coloured as to be, for all practical purposes of comparison, equivalent to the plants which they copy with such minute fidelity. Even as an ornament for a drawing-room table the book is not without its value.

Our Difficulties and Wants in the Path of the Progress of India. By Syed Mohammad Hossain, M.R.A.C. of Lucknow. (London: W. H. Allen & Co.)—This work of a thoughtful native, written in excellent and readable English, will, we hope, find its way to the India Office. It is impossible to govern any country upon purely theoretical principles, and the practical lessons to be learned from the study of grievances from the point of view of the persons aggrieved are never lost upon the true statesman. Accept-

ing Mr. Hossain's statements as in the main correct, there is apparently much that calls for reform in the details of our local Indian administration.

The Botany of Bermuda. By General Sir J. H. Lefroy, F.R.S. (Washington, 1884.)—This is a *catalogue raisonné* of the whole of the vegetable productions (fungi excepted) of Bermuda, by its quondam Governor, and forms a very useful contribution to botanical science.

Public Examination Scripture Manuals. The Church Catechism. By Arthur Riches, F.R.A.S. (London: Relfe Bros.)—The chief value of Mr. Riches' little book lies in the detailed explanation it gives of the various questions in the catechism, and of the replies to them; the illustrations of which are abundant and complete. The Revised Version of the New Testament is quoted throughout.

We have received, too, Dr. H. E. Armstrong's Address *On the Teachings of Natural Science*, delivered at the Health Exhibition on Aug. 5, in which the author, as we think legitimately, finds grave fault with the existing system of science teaching, and offers eminently practical suggestions for its improvement. Although Dr. Armstrong derives his illustrations from that branch of science with which he is especially identified, chemistry, yet his remarks may well be laid to heart by teachers of other scientific subjects.

THE FACE OF THE SKY.

From November 7th to November 21st.

By F.R.A.S.

The sun will be examined on every clear day with the telescope for the spots and groups of spots and faculæ which still continue to appear. Map XI. of "The Stars in their Seasons" shows the aspect of the night sky. On the night of the 15th, a maximum of χ Cygni will occur ("The Stars in Their Seasons," Map IX.). At and after midnight, from the 12th to the 15th, and especially on the 13th, watch should be kept for the shower of shooting stars which seems to radiate from a point to the right of ζ and γ Leonis ("The Stars in their Seasons," Map IV.), hence called the "Leonids." Mercury is, for all practical purposes, invisible during the next fortnight. Venus continues to be a morning star, but rises later and sets sooner every day. She is still very brilliant before sunrise. Mars is invisible. Jupiter rises about a quarter past 12 at night on the 7th and at 11h. 22m. p.m. on the 21st. Hence he is inconveniently situated for the ordinary amateur observer. We shall not give any details of the phenomena of his satellites until they begin to occur before midnight. Saturn is visible during practically the whole of the working night; he is still a little to the north of ζ Tauri ("The Stars in their Seasons," Map. I.). Uranus cannot be seen; but Neptune may be fished for in the confines of Aries and Taurus, in a blank region of the sky. The moon enters her last quarter at 11h. 22·4m. p.m. on the 9th, and will be new on the 17th at 6h. 11·7m. in the evening. Hence but little will be seen of her during the succeeding fourteen days. She will occult two stars only at convenient hours during that time. The particulars of the first occultation were given a fortnight ago, but we will repeat them here. To night, then, at 11h. 14m. the 5½ mag. star, 68 Geminorum, will disappear at the moon's bright limb at an angle from her vertex of 35°, reappearing at her dark limb 14 minutes after midnight at a vertical angle of 237°. To-morrow night (the 8th) B.A.C., 2,872, a 6th mag. star, will disappear at her bright limb at 12h. 16m. p.m., at a vertical angle of 50°, to reappear at her dark limb at 1h. 18m. the next morning, at an angle of 213° from her vertex. The Moon is in Gemini to-day, but crosses into Cancer at nine o'clock to-morrow morning (the 8th). Her passage across Cancer takes her until 11 p.m. on the 9th; when she enters Leo. Through this she travels until 5 a.m. on the 11th, when she descends into Sextans; re-emerging in Leo at 4 o'clock the same afternoon. She does not finally quit Leo for Virgo until 5 p.m. on the 12th. It is 2 a.m. on the 16th ere she has traversed this great constellation and entered Libra; her passage across which occupies her until 3 a.m. on the 18th. She then enters the narrow northern strip of Scorpio, leaving it at 1h. 30m. the same afternoon for Ophiuchus. This she traverses by 1 p.m. on the 20th, when she crosses into Sagittarius. She is still in Sagittarius when these notes terminate.

Miscellanea.

It is stated that Lieut. Greely is about to visit England with the view of publishing here his work on "Arctic Exploration."

The only Gold Medal for maps gained by any British exhibitor at the International Health Exhibition, South Kensington (Class 48, Education), has been awarded by the International Jury to Mr. Edward Stanford's exhibit in the Royal Albert Hall.

M. Alph. Favre has, says the *Athenæum*, constructed a map of the erratic phenomena and ancient glaciers on the northern slope of the Swiss Alps, and of the Mont Blanc range. This map is drawn to the scale of 1 : 250,000, and indicates the extreme development of the old glaciers, the glacial drift, erratic boulders, and moraines deposited during the period of glaciation.

Mr. Eltringham, boiler-maker, South Shields, has just lighted his works by means of twelve Brush arc lamps, driving the dynamo machine from his works engine. The work has been carried out by the Hammond Electric Light and Power Supply Company, and great satisfaction is expressed as to the way the installation has been made.

Professor Milne in the *Transactions* of the Seismological Society of Japan publishes a paper "On Earth Tremors," in which he deals with natural tremors and such as are artificially produced, and he describes the instruments constructed to record these minute movements. These motions appear to be more regular than earthquakes, and as yet the two disturbances cannot be connected. The new branch of science which is directed to the observation of these minute tremors is to be called micro-seismology.

"Put in a Penny and Pull out a Post-card Company."—A correspondent writes to the *Morning Post*:—"Will you allow me, through the medium of your columns, to thank the directors of the 'Put in a Penny and Pull out a Post-card Company' for their excellent invention, by means of which anybody can, by dropping a penny into the machine, obtain a post-card? Anxious to instruct a cousin of mine in the working of this invention, I yesterday dropped the required coin into a machine in the Central Gallery of the Health Exhibition, and was pleased to find that I was rewarded for my trouble by receiving no less than seven post-cards. I trust that more of these interesting and useful conveniences may shortly be scattered over the metropolis."

The editors of Dickens's correspondence have ascertained that a most interesting record of his connection with the *Daily News* is still in existence. This is a diary kept by the sub-editor, Mr. Dudley Costello, containing the directions given by Dickens from day to day as to the conduct of the journal. The subjects for leading articles are noted, and directions are given as to the persons by whom they are to be treated, and the manner of treatment. As the editor of *Household Words* and *All the Year Round* Dickens is known to have been most careful in selecting subjects and supervising his contributors, and it now appears that he had been equally vigilant when editing the *Daily News*. When these fresh particulars are made public, an interesting view will be given of a part of his career about which comparatively little is set forth in his biography.

Snake Mortality in India.—From a Government return issued within the last few days it appears that in the year 1882, 19,519 human beings lost their lives through the bites of venomous snakes in the presidencies and provinces of British India alone. This is a higher number than any reported in the previous seven years, but the increase may be more apparent than real, and due to the returns from outlying districts being more complete. The highest number of deaths is reported from Bengal—9,191; next come the North-West Provinces and Oudh, with 5,680; Bombay, with 1,190; the Central Provinces, with 1,058; the Punjab, with 929; and Madras, with 920. During the same year rewards amounting to £1,487 were paid for the destruction of 422,421 snakes.—*Medical Press and Circular.*

Death from Lightning.—At a recent congress of German medical men, held at Magdeburg during the end of September, a paper was read by Herr Heusner on the effects of lightning stroke on human beings, and the author showed that when the lightning discharge passed through the skin its passage was much easier, that is to say, the internal organs are much more conductive than the epidermis. This fact was pretty well known, but it is not so well-known that the brain and spinal cord are apparently conductors, and hence a lightning stroke on the head does not materially injure the brain beyond shattering the nerves, and causing temporary derangement. Most persons struck by lightning do not remember anything about the stroke; but others describe a sensation such as would be caused by their being struck a heavy blow, and some have likened the shock to what they would be supposed to feel if torn into small pieces. The subject is an obscure one, but happily it is

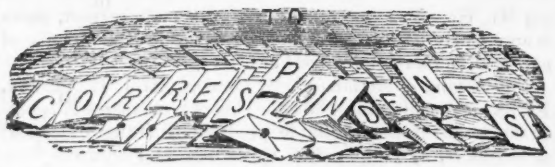
XUM

now beginning to engage the attention of physiologists as well as physicists.—*Engineering.*

THE success of the Health Exhibition was not assured from the outset. But curiosity to know what it would be like helped it in its early days. The opening ceremony was performed to time; but the inflow of visitors, through the incompleteness of the arrangements and the known arrears, was slack. The third week of May, however, found the public current flowing in on a par with the like period of the year before. From this time forward the popularity of the Healtheries exceeded that of the Fisheries. In June the weekly totals were 154,000, as against 73,000 in the previous year. From June to the end of July the superiority of numbers became still more marked, the weekly totals rising to 170,000, as against 94,000 in 1883. In August the average weekly totals were 171,000, as against 115,000. The proportion in September rose yet higher, being 187,199 to 107,103. Since then the ratio of the totals has been further increased, the three weeks to October 18th averaging 216,615, against 127,698. The following week's total was 260,575. The grand total of the Fisheries returns was 2,703,051 at its close on October 31st. The grand total of the Health Exhibition returns up to the close amounts to 4,167,683.

ROYAL VICTORIA COFFEE HALL, WATERLOO-BRIDGE-ROAD, S.E.—On Tuesday, 28th ult., a lecture was given by Mr. J. W. Groves at the above hall on "Plant and Animal Mimics," S. Morley, Esq., M.P., in the chair. The lecturer explained that the mimicry in question was unconscious, and its end was usually either to protect the animal or to enable it to reach its prey unperceived. Thus the lion was the colour of the desert sands, so was the camel. The tiger was striped so as to be hidden among the brownish leaves and stems of the bamboo. The leopard's spots made it difficult to be seen among the shadows of foliage. Turning to fish, the flounder, sole, and many others were marked and coloured like the sand and shingle. Among birds, the ptarmigan was not only coloured in summer so like the heather that the dogs pass close to her without perceiving her, but her winter plumage was white like the snow, and the colours of most hen birds were adapted for concealment while they are sitting. But in the insect world protective resemblance was carried to its highest perfection. The leaf insect was hardly distinguished from the leaves it frequents, and the stick insect, used in the manufacture of artificial flowers. Some insects were protected by having such an unpleasant taste or smell that the birds learned to leave them alone, while others, without the unpleasant taste, were protected by being shaped so like the others that they were mistaken for them. A large number of photographic lantern illustrations were shown. The next lecture will be on Nov. 4 by Rev. W. Tuckwell, the subject, "A Bank Holiday among the Hills." Some unusually good ballad concerts have been arranged for the Thursdays in November at the above hall. On Nov. 6 Mdme. Evans Warwick will give the concert, in which the talented Mdme. Adeline Paget, as well as other popular artistes, will take part.

A FEW days since a little girl, whilst attempting to cross the road in Northgate, Hartlepool, was run down and killed by a steam tramcar. Every effort was made by the driver to warn the child of her danger, but without avail, and her body was dreadfully mutilated. There is no reason on earth why this sort of result should follow such an accident, and if tramway vehicles were properly guarded it would be impossible; and such fatal results would not accrue if due and proper precautions were taken by oramway managers. Of late a number of similar fatal accidents have occurred in different parts of the country, and which would not have proved fatal if proper means had been adopted to prevent those who happen to be on the line from passing under the car. At one time no attempt was made to provide cars with any guard by which any obstruction would either be carried along or pushed off the rails, instead of being run over. Latterly, on some lines guards have been affixed to cars in certain towns, which would in most cases push a person along or off the rails, but these are not yet attached to all. Considering the nature of tramcar traffic, whether horses or steam motors are employed, it should be considered imperative, if only in the interests of tramway companies, that the best means of preventing fatal accidents should be provided. In very few cases, however, has this been done, and it can hardly be looked upon as less than criminal negligence that this should be the case. A guard which would be effective in preventing even a child from passing under a car or tramway engine from the front could be made by almost any mechanic who might be asked to do it, and it is high time that all tramway companies should be called upon to provide all cars and tramway engines with such a guard. There is nothing to prevent the application of a form of cow-catcher to all tramway vehicles, and it should be within the power of the Board of Trade to call upon all tramway owners to adopt such a thing under compulsion.—*Engineer.*



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

All Remittances, Cheques, and Post Office Orders should be made payable to MESSRS. WYMAN & SONS.

The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

WINE COOKERY.

[1493]—The revelations of Professor M. Williams in your pages are deeply interesting. Will he kindly supplement them by other instructions in elementary analysis of wine?

Some years ago I experimented, according to "Griffin's Wine-testing," upon various kinds as to their alcoholic strength, acidity, and saccharine matter; but that system gives no help in detecting adulterations. So, after reading your articles of the 10th and 24th inst., I made a saturated solution of barium chloride in distilled water, and added a little to test-tubes containing different wines. The effect on choice dry sherry *was* a caution! Madeira showed only a slight turbidity, hock slightly more, and claret hardly any. Is this substance as good a test for these other wines as for sherry? And does it follow that there must also be a precipitate in the process of digestion?

As to the late ex-Emperor, it was said that his favourite wine was champagne rather than dry sherry; and I have heard it stated that one danger of the former is that it may be only rhubarb wine in disguise, because that means oxalic acid; and where much lime (whether in water or in food solids) is taken simultaneously, that means a deposit of oxalate of lime, or calculus, the disease to which Louis Napoleon succumbed. Supposing this to be true—of which I know nothing—it would seem to be prudent in the male sex to avoid rhubarb as a vegetable altogether.

There are, no doubt, many of your readers who, like myself, find they are better with a little (a very little) wine, than without; and Professor Williams would earn our best thanks by telling us how to detect deleterious substances (other than sulphuric acid) in the wines commonly met with. VILE POTABIS.

COCOA *v.* TEA.

[1494]—Supplementary to Mr. Mattieu Williams, my own experience of the relative effects of tea and cocoa may be not without interest. Up till about February of the present year it was my custom to take cocoa daily about 5 p.m., falling asleep at nights within half-an-hour of retiring. For seven months after that period (till a fortnight ago, in point of fact) I substituted tea for the cocoa, with the result, as I now know, of inability to attain somnolency within 1½ to 2 hours after going to bed. The cause was suggested by certain correspondence which of late has appeared in the pages of KNOWLEDGE. It is almost superfluous t add that the cause has been removed; I have reverted to cocoa-drinking, and once again enjoy a respectable quantum of "tired nature's sweet restorer." JOHN BELL.

EUCLID'S THEORY OF PARALLELS.

[1495]—In your "Chats about Geometrical Measurement," p. 337, line 5 from end, you say that Euclid's 12th Axiom is "no axiom," as "the converse is demonstrated in the 17th Proposition." If this were the *logical* "converse" of the axiom, so as to follow immediately from it, there *would* be some absurdity in making the first statement an axiom and the second a theorem. But this is not so. The two statements are of the form "all X is Y," and "all Y is X;" and it is so far from being the case that, if one of these be axiomatic, the other is axiomatic, that it may easily happen that one is axiomatic, while the other is not even true.

Again, at p. 338, col. 1, last line, you say "it is evident that K L = C H." If this were once granted, you would not need the diagram in col. 2, you need only say "join H K. These triangles have all their sides equal. Therefore angle C K H is equal to angle K H L. Therefore the three angles of the triangle H C K are equal to the three angles K C H, H C K, K H L, *i.e.*, to two right-angles. But *any* given right-angled triangle may be treated like this, and any triangle may be divided into two right-angled triangles. Hence the angles of any triangle are equal to two right-angles." This proves Euc. I. 32, after which all is easy.

Again, in col. 2, you claim to have *proved* Simson's axiom that two lines through a point cannot both be parallel to a third line. But you have only proved this for "parallels" as you define them, viz., "lines which have a common perpendicular," and so have not proved *Simson's* axiom at all. This is, I fear, a logical flaw in your argument. C. L. DODGSON.

Ch. Ch., Oxford.

"WHAT LARGE EYES YOU HAVE, GRANDMAMMA!"

[1496]—Whoever walks through a good collection of fossils, arranged according to strata, or turns over many engravings of them, is likely to be struck by one distinction, I think, between the majority of animals prior to a certain date and all those since. Those that now have eyes, or that had them in the Tertiary, the Cretaceous, or the Wealden times, have those organs very small compared to the great eyes prevalent of old both in the vertebrate and lower classes. If our crocodile be descended from the ichthyosaur, for instance, or our shrimp or crayfish from a trilobite, might not these moderns address to their ancestors Ridinghood's exclamation to her sham grandam? Is any reason yet suggested for this seemingly sudden and unique change of fashion between the Oolite and Wealden days? If not, I can propose one; but would like to hear first of any existent theory. E. L. GARBETT.

MAY-FLIES.

[1497]—Mr. F. W. Halfpenny's query (1487) will be found answered in KNOWLEDGE for Oct. 10, p. 294. May-flies are the only insects that cast the skin after acquiring wings.

E. A. BUTLER.

THE ECLIPSE OF THE MOON OF OCT. 4.

Morar, Oct. 5, 1884.

[1498]—I have witnessed many total lunar eclipses, but for impressiveness, completeness, and length, none approach that observed last night.

In every sense of the word it was a total eclipse, the moon being almost obliterated from the sky for an hour and a half. To the naked eye, a mere nebulous blotch remained, recognised with difficulty, and a powerful binocular only just revealed the disc.

The totality I have hitherto observed has always been confined to a rusty or smoky veil, through which the lunar surface was distinctly traceable. In the present instance, an inky pall veiled the orb entirely, and its nature was revealed at first contact, for it was at once apparent that the moon was caught in the umbra, the penumbra being barely visible (Fig. 1). During totality, you could dimly discern through the inky pall a still blacker configuration,

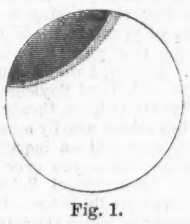


Fig. 1.

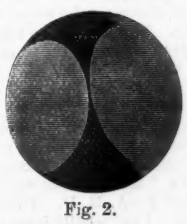


Fig. 2.

as if of two triangular continents connected by a lengthy isthmus (Fig. 2). This eclipse was further characterised by a combination, I fancy, of rare occurrence, and that was an occultation. The behaviour of the star was quite new to me, for it certainly descended (apparently) behind the moon, from its position to her N.E., as regarding the top of the moon as N. I did not witness emergence.

Kindly let me know if you noticed at home the blackness of this eclipse, and what I have advanced regarding the occultation.

R. F. HUTCHINSON, M.D.

[Dr. Hutchinson's observation, made at a distance of upwards of 4,500 miles from Greenwich, as measured on a great circle, possesses high interest; as showing that the extraordinary obscuration of the moon during the late eclipse, so far from being local, was seen over a very large area of the earth's surface; and lending additional weight to the idea that it must have had its origin in the existence of some semi-opaque material in our own atmosphere which hindered the ordinary refraction of the solar light into the earth's shadow. The markings shown in Dr. H.'s sketch of the totally-eclipsed moon I am unable to explain. Numerous minute stars were occulted in England during the eclipse, but, of course, parallax would carry the moon wide of these as viewed from Gwalior.—ED.]

TWO-SPEED GEARINGS.

[1499]—C. Webb can have Hirst's two-speed gearing applied to his front-steering tricycle. The increase in the weight of the machine would be about 5 lb. to 6 lb. The change can be made best from speed to power while travelling. The same crank will answer if there is length sufficient to take the lower clutching apparatus. As regarding price, I must refer Mr. Webb to the maker.

JOHN BROWNING.

A NEW PHOTOMETER.

[1500]—The following is, I believe, an entirely new discovery, and, at all events, sufficiently important to bring before your readers. It is due to Dr. Gorham, of this town. It is a well-known fact that the iris performs the duty of regulating the amount of light which passes into the interior chamber of the eye by enlarging or contracting the diameter of the pupil. But has it ever occurred to any one before that the eye can be used as a photometer? By means of a little instrument of his own invention, Dr. Gorham is able to measure the diameter of his pupil, and has proved, by a series of measurements, the number, of which he reckons by thousands, that, for the same kinds of light, the measurement of his pupil is invariable. The gradual diminution of the size of the pupil as dawn gives way to daylight, and the increase as daylight gives way to evening twilight—the minimum being reached about an hour or an hour and a half after midnight—on each successive day, combined with numerous experiments on candle-light, gaslight, and other lights seems to place it beyond doubt that Dr. Gorham's pupil photometer is an accurate way of comparing the intensities of various sorts of light. Is it not a curious thing that this fact was not discovered years ago? To my mind, this photometer far excels those of Rumford or Bunsen.

Tonbridge. E. A. TINDALL.

[That Dr. Gorham's "Pupil Photometer" will ever supersede those of Rumford or Bunsen as a *quantitative* measurer of light, is, I think, very doubtful. Will Dr. Gorham—or Mr. Tindall—favour us with a more detailed description of it, though?—ED.].

TRADUCING A TALISMAN.

[1501]—The "potent talisman" in letter 1490 is only our old friend the "magic square" thinly disguised.

8	11	14	1
13	2	7	12
3	16	9	6
10	5	4	15

Add 1479 ($= 29 \times 17 \times 3$) to each of the numbers 9 to 16, and you may imagine yourself "to have full command over demons, fairies, and enchanters." But whether this happy result is produced by the magic square arrangement or by the addition of 1479, probably only the Asiatics (whoever they may be) can say.

If "A Lover of Things Occult" wishes to probe the dread secret of his talisman, he may at his leisure verify the statement that there are exactly 72 ways in which, by adding together four of the numbers on it (more or less symmetrically arranged), he may obtain 2,992. I do not understand "things occult," but I should imagine this ought to be done at midnight amidst suitable surroundings—skull, cross-bones, &c. W.

LETTERS RECEIVED AND SHORT ANSWERS.

J. MURRAY.—You need not be under the slightest apprehension of ever becoming too wise; or that, during your brief span of life, you will, in respect to knowledge, ever be like Alexander, who wept because he had no more worlds to conquer.—SIRIUS states that last year's phenomenon of a green moon is now recurring, and was seen at Anerley on the 26th ult. If you read through the articles on

"Nights with a 3-inch Telescope," you will find all the leading double stars and nebulæ, which are well within the power of such an instrument, are described and a large proportion of them illustrated.—"F.R.A.S." writes that he is only waiting until the inexplicable haze which has surrounded the sun for so many months disappears, to complete his series of papers with a drawing and description of Mercury.—JOHN SEWELL. In these columns.—H. D. I have never heard of the publication of any work on the arrangement of facts. Why do you not get a shilling memorandum-book, and divide it into sections headed, Philosophy, History, Politics, Theology, Literature, Science, &c.; subdividing the latter into Mathematics, astronomy, physics, natural history, and so on; and enter your facts under their appropriate headings. I regret that your former letter was overlooked, as it very well may have been, among the hundreds received.—WM. J. DAVIES. I cannot understand how brilliance, however intense, could convert the visible portion of the moon's limb into a seemingly parabolic curve. I should rather refer this illusion to the intersection of the two arcs of different curvature, those, I mean, of the moon's limb and of the periphery of the earth's shadow. See KNOWLEDGE, Vol. I., p. 70.—A COUNTRY LAD. I have never even heard of the book you mention, which is assuredly *not* a "standard" one. The second person you mention is a mere ranter, and is not the very slightest authority on any scientific question whatever.—MUSAFIR. See reply to "The Ghost of a Little Boy," on p. 373. The latter half of your letter has been anticipated in a hundred cases, as you will ere this have learned.—JOS. W. ALEXANDER. Very much too long for insertion: a thing to be regretted, inasmuch as you advance something worthy of serious attention, could you only compress it into about a tenth of the space.—ENQUIRER. Probably your "Man-frog" *did* swallow some water with his cake. The performance is quite genuine. Beckwith, of London, Reddish, of Liverpool, and others continue to do the same thing.—W. H. S. MARK. The subject has been sufficiently discussed.—JOHN BELL. They will be re-published in a book-form, upon their completion here.—IGNORANCE. From the most elementary properties of numbers. See any book on the higher arithmetic. The date of the submersion of oak in bogs varies. In Denmark, the fir-tree seems to have flourished in immediate succession to the last Glacial Period. This was succeeded by the oak, which was coëval with the "bronze age" of anthropologists, as that was in turn by the beech. Sir Charles Lyell ("Antiquity of Man," p. 17) says that there is nothing in the growth of peat opposed to the conclusion that the Danish bogs may be 16,000 years old. I know nothing specifically of the Newmarket "Devil's Dyke;" but it is a name applied all over the country to Roman and other fortification lines.—THOMAS WILLCOCKS and R. COUPLAND THOMAS. You will see from the announcement on p. 329, that the "Life after Death" controversy is now closed. Yours are both letters which cause me to regret that they did not reach me sooner. Quires of correspondence on this subject found their way into the waste-paper-basket.—A. G. There is nothing to wonder at when we remember that refraction raises an object really on the horizon nearly 3′5 (or more than the diameter of the sun or moon) above it. Had our atmosphere been removed, the eclipsed moon would have set before sunrise.—GEORGE R. SAUNDERS. Visible occultations of planets by the moon are not very common, but are by no means the rare phenomena you imagine. For example, Venus was occulted on Feb. 29th of the present year (see Vol. V. of KNOWLEDGE, p. 131); Mars was occulted on June 3, 1878, &c. For the dates of such occultations I can only recommend a hunt through back volumes of the *Nautical Almanac*.—Z. If by "names of the Stars" you mean their Arabic names, you will find these appended to the maps published in our earlier volumes, and reproduced in "The Stars in their Seasons." It would crowd the projected maps to an extent rendering them scarcely intelligible were the name of each individual star printed against it.—LANCASHIRE. No reward has ever been offered for the trisection of an angle or arc. Besides, if there had been, yours is not a solution. The problem is an *impossible* one, if you are confined to the straight line and the circle. For approximate mechanical methods, see Vol. I. pp. 117 and 166.—G. H. DANN sends me a copy of the *Port Elizabeth Telegraph* (South Africa), with carefully-written local "Astronomical Notes" for October.—DR. GROTH. I have read your pamphlet entirely through. Forgive me for saying it is full of fallacies from beginning to end. (1) Gravitation cannot possibly be identical with electrical action. The latter takes a perfectly measurable time to travel; the action of gravity must be *instantaneous*. If not, you, with your mathematical attainments, must see at once how the motion of the earth in her orbit would be affected. (2) Orbital motion, *per se*, could never cause axial rotation. (3) The idea of the sudden recession of the earth from the sun at the epoch of the flirting off of each successive interior planet is wild in the extreme. The mass of Venus is $\frac{1}{401085}$th, and that of Mercury $\frac{1}{4862134}$th, that of the sun! What sensible or appreciable difference could the abstraction of these infinitesimal fractions of the sun's mass have upon his attractive power at the earth's distance? (4) Your assumption of the sun's *fluidity*, when he was even hotter than he is now, is perfectly unwarranted. See "The Sun a Bubble," in "Science Byways." (5) Your dynamics are not as the dynamics taught at Cambridge in your view of the formation of the planetoids. Your alleged cause is wholly inadequate to produce any such effect. (6) Your "Glacial Period" theory postulates the creation or projection of Mercury from the sun within the human period on the earth! (7) "Phosphorescence" is *not* seen on Venus "near the time of the planet's greatest elongation," but when she is in inferior conjunction. (8)—But need I proceed? *Ex uno disce omnes*.—Some ANONYMOUS CORRESPONDENT sends me "La Petite République Française," with a pretty severe historical retrospect of the martyrdom of Étienne Dolet. Men consigned their theological opponents to material fires in those days. Now, they condemn them to an immaterial conflagration; but the old spirit survives.—A. H. SOMERSCALES forwards a cutting from a Hull paper of the most remarkable tides which have been observed at Hull during the week ending Nov. 1, and what seems in some way to have been referable to the very heavy N.W. gale which blew on October 26. On that day it was high water at 10h. 40m. a.m. and 8h. 40m. p.m. Moreover, after flowing for 1h. 20m. after its theoretic time, it held up for three-quarters of an hour. A similarly anomalous condition of things appears to have prevailed up to October 29.—DR. DAVEY sends me a small volume of his own "On the Nature and Proximate Cause of Insanity," published in 1853, in which reference is made to a paper by the author in the *Lancet* for 1844. Forty years ago we find Dr. Davey insisting on the duality of the brain, and pointing out that the doctrine is as old as Boerhaave, and possibly even as Hippocrates! I intimated on p. 287 that a packet of re-directed letters had somehow gone astray. This was written at the end of September. This morning (Nov. 3) the packet has turned up! having been delayed by carelessness so utterly scandalous as would have ensured the dismissal at once of any one in private employment, but which is simply "regretted" by the Post Office. Luckily, beyond a Post Office-order sent by J. KENNEDY ESDAILE, it contains nothing of great importance. Had Mr. E. only addressed his letter to the *Publishers*, this would have reached them some five weeks sooner.—W. B. writes on "Brain and Mind."—ALBERT WILLAN, THOS. J. HOGG, PROTEA, H. DAVEY, and E. H. TROWER all send solutions of Mr. Sidder's figure puzzle.—AN ANONYMOUS WRITER who wants a book reviewed, is informed that it only does mischief to give wide publicity to rubbish.—N. S. gives an account of a meteor seen in Guernsey on Sept. 18th; and JOHN E. STEWART of another observed at Dundrum on Sept. 22nd. Thanks to Mr. Fawcett's subordinates, these communications are a little out of date now.—PUZZLEHEAD, FRANKLIN J. SONNENSCHEIN, T. B. S., JAS. SMITH, CHAS. G. DEWBERRY, G. WOODCOCK, HENRY PETERS, FRED. D. HENDERSON, F. G. S., J. C., and C. L. DODGSON, one and all point out that the "problem" contained in Letter No. 1490 (p. 372) is nothing but our venerable friend, the Magic Square. No one, however, attempts to show the connection between the figures, and the power they are alleged to possess "over demons, fairies, and enchanters."—EDWARD IRVING. I regret that you should be so severely exercised by the expression "undoubtedly." Be this as it may, there can be very little question that the existing date is wrong. Thanks for the kindly conclusion of your letter.—W. CAVE THOMAS. If it be the fact, as you allege, that you "have killed long since" the theory of three primary colours, I would suggest that you should forthwith communicate with Lord Rayleigh, the Professor of Experimental Physics at Trinity College, Cambridge, in order that he, Mr. Glazebrook, and a few others usually accepted as leading authorities on physical optics, may hold an inquest on the remains of the deceased hypothesis. Have you ever read Nood's "Modern Chromatics," in the "International Scientific Series"?—A. M. D. Thanks for your very friendly letter.—H. N. SMITH. I am wholly ignorant of the extent to which the late Mr. David Urquhart cooked himself in the Turkish bath, or what was the maximum heat he there endured. Chabert, the "Fire King," remained in an oven while meat was cooked, but, of course, he stood upon felt or some other non-conducting material, while the meat lay upon heated metal. A surreptitious test of his oven, though, showed the temperature to be 220° Fahr., and the steak was grilled on concealed charcoal embers.—J. R. SMITH. I accorded you all the space at my disposal on pp. 348 and 349, and can assuredly spare you no more, merely to reiterate, without one fragment or atom of *proof*, that brass was a "primordially formulated metal"—and so on. You entirely ignore the offence (not to say disgust) given to a large mass of readers who really possess some knowledge of the rudiments of science, by the insertion of such utterly wild and foundationless guessing as yours.

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

A GOOD GREENHOUSE BOILER.

We are now in full view of those night frosts which occasion such anxiety to all who have choice plants in their conservatories and greenhouses. Such horticulturists as may not be satisfied with their existing warming arrangements will, doubtless, be interested to know that Mr. J. Watson, florist, of St. Albans, Herts, has invented what is known as Watson's Patent Double-Action Suspension Arrangement. It is stated that quite half the usual cost in fuel is saved by using this boiler, which is claimed by the inventor to possess all the good qualities of the single-action patent (of which about 200 have been sold, without a failure), while it has nearly double the heating surface in the same size boiler. The cost of this boiler is economised, it is stated, in fuel, and it is claimed to be far superior to the saddle and wedge for large quantities of piping. It is manufactured, we understand, from the very best ¾-in. wrought iron, and has the additional advantage of requiring the most simple setting. Orders for these boilers should be sent to Messrs. S. E. Ransome, 10, Essex-street, Strand, who are, we understand, the sole agents for Watson's well-known patent hot-water apparatus.

AN ECONOMISER WATERING-CAN.

Many persons fond of gardening, more particularly invalids having indoor plants, would, we fancy, like to know of a can that does not spill water over the ground or carpet, and which is capable of entire regulation as to flow with perfect ease. Messrs. J. Kaye & Sons, of 93, High Holborn, have invented a watering-pot of this description, for which the following advantages are claimed:—A neat and handy shape, favouring the admission of the pot (without catching) over and between plants closely arranged. Repeated tilting is needless, as the flow is let off by a touch of the valve, and the water can be so controlled (measured practically to the drop) that no overflow occurs nor does the foliage get wetted. The flow can be so regulated that vexatious and unsightly stages from the displacement of soil of newly-potted things may be entirely avoided. There is a total absence of "flushing." Then, again, secondary advantages accrue from the foregoing, as the saving of water and carrying; dry floors, so essential in winter, and desirable, too, in summer, until the watering is finished, in order to keep the feet dry. Among those for whom these improved watering-cans are specially calculated to be really serviceable are ladies and amateurs who wish to avoid the annoyance of escaping water, also those growing plants in carpeted rooms. The professional gardener, too, will find it a handy pot for such things as orchids, ferns, &c., requiring moisture carefully given. Finally, invalids, who so much enjoy the pastime of flower-growing, will find it the very article they need.

AN IMPROVED LAMP-BURNER.

Messrs. Hinks & Son, of Birmingham, and the Holborn Viaduct, London, have invented an interchangeable, lever-action, duplex burner (Joseph Hinks's patent), which supplies a facile means of lighting and trimming a lamp without removing the cone, globe, or chimney. The new burner possesses neither spring, bolt, hinge, nor other complication, so that it cannot readily get out of order, while it will accurately fit any of Hinks's ordinary past or present duplex lamps. A slight turn of the lever-key causes cone, globe, and chimney to smoothly ascend, thus giving free access to the wicks for trimming and lighting. The movement being perpendicular, the danger of over-balancing, breakage of glass, smoking of cone, or straining of mechanism (inseparable from all tilting or hinge arrangements), is obviated. With this arrangement a full light is maintained to the last drop of oil. By removing screws from bottom of slide-rods and of lever-rod, the burner can be taken to pieces. All persons using ordinary lamps will appreciate this invention, and accept it as a long-sought desideratum.

FURNACE SLAG AS A FINE ART MATERIAL.

What is claimed to be a marvel of inventive science has just formed a rather prominent exhibit at the late Brewers' Exhibition, and consists in a utilisation of that waste product, blast-furnace slag, into a material capable of being wrought up into a variety of art works. Slag is a mixture of minerals and silicates fused by the furnace, and so beautifully coloured by metallic oxides as to rival the finest marbles. Its extraordinary hardness, however, defied all tools, and it was only after seven years of experiments that a German chemist invented the means for softening the slag chemically, and while thus plastic, forcing it into steel moulds under hydraulic pressure. The substance then, while taking the finest art forms, retains all its delicate grain and variegated markings which constitute its special beauty. The Artistic Pottery Company, of Churson Works, Western-road, Wood-green, N., have taken up the conversion of slag into a great variety of ornamental and artistic articles, and as these range in price from sixpence to five guineas, it may be inferred that the range of the company's productions is very wide.

THE "CESTUS" BOILER.

At the recent Brewers' Exhibition, among the new inventions exhibited was one known as the "Cestus" boiler, for which the following important advantages are claimed:—Simplicity of construction, facility of access for examination or repairing, and, finally, great evaporative efficiency, and, as a resultant, economical use of fuel. Details may be had of the sole licensee, Mr. H. Fletcher. The only agents in London for these boilers are Messrs. Stevenson & Davies, of 11, Queen Victoria-street, E.C.

A PORTABLE KITCHEN.

Multum in Parvo is undoubtedly a guiding principle with much of the invention of the day, and it is very emphatically the case with the "Patent Compactum Cuisine," the invention of Mr. Alfred Parkes, of Zoar Works, Wolverhampton. This is quite like a conjuror's puzzle, for in a neat case resembling a rather large tin collar-box there are stowed away a saucepan and a kettle, each holding two pints, a basin, a frying-pan, a stand for lamp, tea and sugar caddies, tea-strainer, two cups, two teaspoons, a spirit-flask, two enamel plates, two knives, two forks, a water-pail, a spirit-container, a matchbox, and last, but by no means least, a "Hecla" lamp, with measure. This lamp is a well-constructed article, made of yellow metal; by the peculiar action of the methylated spirits, it produces a gas which is practically unextinguishable by wind or rain. The "Compactum" contains, in point of fact, just 25 articles, all well made and thoroughly fit for use.

LIFE-SAVING APPLIANCES.

That deaths from drowning—one of the most preventible forms of casual mortality—multiply is well known, and this fact has happily stimulated invention to furnish means for minimising water-risks. Cork has hitherto been greatly relied on, but it is not, we think, generally known that that material loses its buoyancy when exposed to damp. Even and granulated cork, so much relied on, loses, soon after immersion, one-fourth of its sustaining power. Mr. Joseph Sexton, of 3 and 4, Great Winchester-street, London, E.C., uses vaselin to treat cork, and by this simple means renders its buoyancy permanent. He encloses the cork, too, in waterproof cylinders, thus doubly protecting it. Experiments with life-belts made upon Mr. Sexton's principle have been tried at several of our sea-ports, and have given the most satisfactory results, the testimony of all who witnessed the tests being emphatically in favour of these belts. Mr. Sexton has also perfected an improved deck-seat on this principle for use in passenger vessels.

AN IMPROVED UMBRELLA.

Greatly as umbrellas have been improved of late years, there is still room for further progress. For one thing, umbrella-sticks are never strong enough to resist a really high wind properly unless when, on quite a clumsy scale, inadmissible in the case of those designed for ladies. Mr. William Temple Stephens, of 115, Wood-street, Cheapside, London, has, however, invented what seems to be a decided improvement in the springs and attachments of the same to the sticks or canes of umbrellas, parasols, or sunshades. The improved spring, of iron, steel, brass, or other metal, may be flat or round, and is secured by simply drilling two holes in the stick. One end is passed through one hole and rivetted in the usual manner. The spring may lie along the stick, for neatness, in a shallow groove, its other end terminating in a hook, shorter than in general to enable it to work in the other hole, which is slightly slanting and pierces the stick only for two-thirds of its diameter. The usual stop-wire is put across to keep the spring in position. The point of this invention is that the improved spring obviates the necessity for cutting the ordinary slit, which so greatly weakens the stick. This invention can be adapted to any size of umbrella, parasol, or sunshade.

XUM

Our Chess Column.

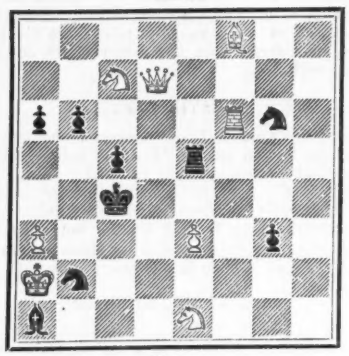
By Mephisto.

PROBLEM No. 135.

By J. Berger.

(From his collection of problems.)

Black.



White.

White to play and mate in three moves.

THE EVANS GAMBIT.

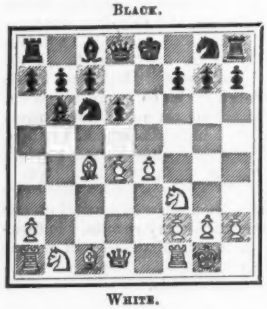
(*Continued from p. 330.*)

1. P to K4, P to K4. 2. Kt to KB3, Kt to QB3. 3. B to B4, B to B4. 4. P to QKt4, B × P. 5. P to B3. Black has two moves at his disposal, viz., (*a*) B to B4 and (*b*) B to R4.

(*a*) 5.	B to B4
6. Castles	P to Q3
7. P to Q4	P × P
8. P × P	B to Kt3

This is one of the main positions in this opening, and may also be brought about by a slight transposition of the moves, such as 6. P to Q4, P × P. 7. P × P, B to Kt3. 8. Castles, P to Q3; or, also, if Black plays 5. B to R4.

Black.



White.

White now has a strong centre position and the better development as compensation for the Pawn.

The continuations at White's disposal are, indeed, numerous. We shall content ourselves with giving a few of the principal attacking variations:

9. Kt to B3	B to Kt5

Steinitz played 9. Kt to R4 instead of B to Kt5 against Tschigorin, which, however, resulted in a bad game.

10. B to QKt5 (*a*)	K to B sq.

Should White play 10. Q to R4, then Black must retire his B to Q2 (see *a*). Now follows 11. B × Kt, P × B. 12. P to K5, B × Kt. 13. P × B, P × P. 14. B to R3 (ch), Kt to K2. 15. P × P, Q × Q. 16. R × Q, K to K sq., with a good defence.

(*a*) 10. Q to R4, B to Q2. 11. Q to Kt3, Kt to R4. 12. B × P (ch), K to B sq. 13. Q to B2, K × B. White obtains a very strong attack, but nevertheless the sacrifice of the piece is unsound. White would continue with 14. P to K5, K to B sq. 15. R to K sq., Kt to QB3. 16. B to Kt5, Q to K sq. 17. P to K6, Q to Kt3. 18. Q × Q, P × Q. 19. P × B, Kt to B3. 20. P to Q5, Kt to K4. 21. Kt × Kt, P × Kt, threatening B to Q5 with a good defence, as the White P's on Q5 and 7 are weak.

We have given the above variation at length to show how dangerous are the attacks in this opening. Returning to the position in the diagram, we now proceed with 9. P to Q5, which is the continuation most frequently adopted.

9. P to Q5	Kt to R4
10. B to Kt2	Kt to K2 (best)

Of course if Kt × B, White recovers the piece by Q to R4 (ch). Or, if now White should play 11. B × KtP, Black will obtain a very strong attack by playing 11. R to Kt sq., followed by 12. Kt × B, and on the White Q checking by 13. Q to Q2 threatening the sacrifice of the R by 14. R × P (ch) and 15. Q to R6 (ch), &c.

11. B to Q3	Castles
12. Kt to B3	P to QB3

and although White has a good position, Black ought to be able to defend his Pawn. If on his 9th move White plays

9. R to K sq.	B to Kt5

with a fair defence, for if 10. Q to Kt3, Kt to R4, or if 10. B to QKt5, K to B sq., or B × Kt, &c. White can likewise play

9. B to R3	Kt to R4
10. B to Q3	Kt to K2
11. P to K5	Castles, &c.

Another continuation for White is

9. B to Kt2	Kt to B3
10. P to Q5	Kt to K2

White would not do well to take the KKt and open the Kt's file for the action of the R, therefore 11. Kt to B3, Castles. 12. Kt to K2, Kt to Kt3, &c.

Finally we give a charming little game played by the late Grand Master Anderssen against Lowenthal, the first eight moves being identical with the position in the diagram.

White. Anderssen.	Black. Lowenthal.
9. P to KR3	Kt to B3
(Kt to R4, dislodging the B, is considered best)	
10. Kt to B3	Castles
11. B to KKt5	P to KR3
12. B to R4	P to Kt4

One of the tricks worth knowing is to give up the Kt for two Pawns in a similar position, as the pinned Kt on B3 mostly succumbs to the attack brought to bear upon it and the exposed K. But considering that if White plays 13. Kt × KtP, P × Kt. 14. B × P, Black has the apparently good defence of B × QP. Black's move seemed safe enough. If, in spite of this, White sacrificed his piece, it shows what a wonderful power of penetration and deep combination Anderssen did possess.

13. Kt × P	P × Kt
14. B × P	B × QP
15. Kt to Q5!	

Very fine if now B × R. 16. Q × B first, followed by Kt × Kt (ch), with a strong attack.

	B to K3
16. R to Kt sq.	R to Kt sq.

Black is quite helpless, if B × Kt. 17. P × B, winning a piece.

17. R to Kt3	K to R2
18. B × Kt	B × B
19. Q to R5 (ch)	K to Kt sq.
20. R to Kt3 (ch) and wins	

(*To be continued.*)

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

G. W. Middleton.—You can place eight Queens on the board without attacking each other, as follows:—Q on KR3, KKt5, KB2, K8, Q sq, QB7, QKt4, QR6.

Littlehampton.—If 1. R to QKt sq, B to K sq, 2. Q to K4, B × Kt, and there is no mate.

Clarence.—Many thanks for letter, game, and problem.

Q. T. V. and A. W. Overton.—Solutions correct.

Correct solutions of 134 received from W., W Furnival, R. Champ, H. W. Sherrard, and Scribbler.

Middlesbrough.—No. 133 is incorrect.

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